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(71) Applicants *(for all designated States except US)*: **CROPDESIGN N.V.** [BE/BE]; Technolopark 3, B-9052 Zwijnaarde (BE). **CROP FUNCTIONAL GENOMICS CENTER** [KR/KR]; San 56-1, Shillim 9-Dong, Gwanak-Gu, Seoul 151-921 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CHOI, Yang Do** [KR/KR]; Banppo Tower Apt 102-301, Jamwon-dong, Seocho-ku, Seoul 137-909 (KR). **PARK, Youn-Il** [KR/KR]; Jijok dong 919, 705-401, Youseong, Daejeon 305-330 (KR). **CHUNG, Suck Won** [KR/KR]; Noeun 559-10, Youseong, Daejeon 305-325 (KR). **HWANG, In Gyu** [KR/KR]; San 56-1, Shillim 9-Dong, Gwanak-Gu, Seoul 151-921 (KR). **OH, Jonghee** [KR/KR]; San 56-1, Shillim 9-Dong, Gwanak-Gu, Seoul 151-921 (KR).

(74) Agent: **MISTRY, Meeta**; Basf Se, Global Intellectual Property, Gvx - C006, 67056 Ludwigshafen (DE).

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(54) Title: PLANTS HAVING ENHANCED YIELD-RELATED TRAITS AND A METHOD FOR MAKING THE SAME

(57) Abstract: The present invention relates generally to the field of molecular biology and concerns a method for enhancing various economically important yield-related traits in plants. More specifically, the present invention concerns a method for enhancing yield-related traits in plants by modulating expression in a plant of a nucleic acid encoding a Harpin-a ssociated Factor G polypeptide (hereinafter termed HpaG"). The present invention also concerns plants having modulated expression of a nucleic acid encoding an HpaG polypeptide, which plants have enhanced yield-related traits relative to control plants. The invention also provides constructs comprising HpaG-encoding nucleic acids, useful in performing the methodsof the invention. The present invention also provides a method for enhancing yield-related traits in plants relative to control plants, by modulating (preferably increasing) expression in a plant of a nucleic acid sequence encoding a SWITCH 2/ SUCROSE NON-FERMENTING 2 (SWI2/SNF2) polypeptide. The present invention also concerns plants having modulated expression of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide, which plants have enhanced yield-related traits relative to control plants. The invention also provides constructs useful in performing the methods of the invention.

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Plants having enhanced yield-related traits and a method for making the same

The present invention relates generally to the field of molecular biology and concerns a method for enhancing various economically important yield-related traits in plants. More specifically, the present invention concerns a method for enhancing yield-related traits in plants by modulating expression in a plant of a nucleic acid encoding a Harpin-associated Factor G polypeptide (hereinafter termed "HpaG"). The present invention also concerns plants having modulated expression of a nucleic acid encoding an HpaG polypeptide, which plants have enhanced yield-related traits relative to control plants. The invention also provides constructs comprising HpaG-encoding nucleic acids, useful in performing the methods of the invention. The present invention also provides a method for enhancing yield-related traits in plants relative to control plants, by modulating (preferably increasing) expression in a plant of a nucleic acid sequence encoding a SWITCH 2/ SUCROSE NON-FERMENTING 2 (SWI2/SNF2) polypeptide. The present invention also concerns plants having modulated expression of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide, which plants have enhanced yield-related traits relative to control plants. The invention also provides constructs useful in performing the methods of the invention.

The ever-increasing world population and the dwindling supply of arable land available for agriculture fuels research towards increasing the efficiency of agriculture. Conventional means for crop and horticultural improvements utilise selective breeding techniques to identify plants having desirable characteristics. However, such selective breeding techniques have several drawbacks, namely that these techniques are typically labour intensive and result in plants that often contain heterogeneous genetic components that may not always result in the desirable trait being passed on from parent plants. Advances in molecular biology have allowed mankind to modify the germplasm of animals and plants. Genetic engineering of plants entails the isolation and manipulation of genetic material (typically in the form of DNA or RNA) and the subsequent introduction of that genetic material into a plant. Such technology has the capacity to deliver crops or plants having various improved economic, agronomic or horticultural traits.

A trait of particular economic interest is increased yield. Yield is normally defined as the measurable produce of economic value from a crop. This may be defined in terms of quantity and/or quality. Yield is directly dependent on several factors, for example, the number and size of the organs, plant architecture (for example, the number of branches), seed production, leaf senescence and more. Root development, nutrient uptake, stress tolerance and early vigour may also be important factors in determining yield. Optimizing the abovementioned factors may therefore contribute to increasing crop yield.

Seed yield is a particularly important trait, since the seeds of many plants are important for human and animal nutrition. Crops such as, corn, rice, wheat, canola and soybean account for over half the total human caloric intake, whether through direct consumption of the seeds themselves or through consumption of meat products raised on processed seeds. They are also a source of sugars, oils and many kinds of metabolites used in industrial processes. Seeds contain an embryo (the source of new shoots and roots) and an endosperm (the source of nutrients for embryo growth during germination and during early growth of seedlings). The development of a seed involves many genes, and requires the transfer of metabolites from the roots, leaves and stems into the growing seed. The endosperm, in particular, assimilates the metabolic precursors of carbohydrates, oils and proteins and synthesizes them into storage macromolecules to fill out the grain.

Harvest index, the ratio of seed yield to aboveground dry weight, is relatively stable under many environmental conditions and so a robust correlation between plant size and grain yield can often be obtained (e.g. Rebetzke *et al.* (2002) Crop Science 42:739). These processes are intrinsically linked because the majority of grain biomass is dependent on current or stored photosynthetic productivity by the leaves and stem of the plant (Gardener *et al.* (1985) Physiology of Crop Plants. Iowa State University Press, pp 68-73). Therefore, selecting for plant size, even at early stages of development, has been used as an indicator for future potential yield (e.g. Tittonell *et al.* (2005) Agric Ecosys & Environ 105: 213). When testing for the impact of genetic differences on stress tolerance, the ability to standardize soil properties, temperature, water and nutrient availability and light intensity is an intrinsic advantage of greenhouse or plant growth chamber environments compared to the field. However, artificial limitations on yield due to poor pollination due to the absence of wind or insects, or insufficient space for mature root or canopy growth, can restrict the use of these controlled environments for testing yield differences. Therefore, measurements of plant size in early development, under standardized conditions in a growth chamber or greenhouse, are standard practices to provide indication of potential genetic yield advantages.

Another trait of particular economic interest is that of enhanced yield-related traits of plants grown under abiotic stress conditions. Abiotic stress is a primary cause of crop loss worldwide, reducing average yields for most major crop plants by more than 50% (Wang *et al.*, Planta (2003) 218: 1-14). Abiotic stresses may be caused by drought, salinity, temperature extremes, chemical toxicity and oxidative stress. The ability to enhance yield-related traits in plants grown under abiotic stress conditions would be of great economic advantage to farmers

worldwide and would allow for the cultivation of crops during adverse conditions and in territories where cultivation of crops may not otherwise be possible.

The ability to increase plant yield would have many applications in areas such as agriculture, including in the production of ornamental plants, arboriculture, horticulture and forestry. Increasing yield may also find use in the production of algae for use in bioreactors (for the biotechnological production of substances such as pharmaceuticals, antibodies or vaccines, or for the bioconversion of organic waste) and other such areas.

Background

I. HARPIN

The Type III Secretion System (TTSS) is an exporting machinery specific for Gram-negative bacteria and is found among plant and animal pathogens, but also in endosymbiotic *Rhizobia*. TTSS is postulated to deliver proteins into the host cell to which the bacterium is associated. In plant pathogenic bacteria, the TTSS is a cluster of hypersensitive response and pathogenicity genes comprising about 20 genes, the Hrp cluster. Nine of these genes (the harpin conserved or *hrc*) are conserved among both plant and animal pathogens, eight of them share homology with genes encoding the flagella apparatus (Bogdanove et al., Mol. Microbiol. 20, 681-683, 1996), the ninth, hrcC, is homologous to the GSP outer membrane secretins (Deng and Huang, J. Bacteriol. 180, 4523-4531, 1999). The hpa (hrp-associated) genes contribute to pathogenicity and to the induction of the hypersensitive response (HR) in nonhost plants, but are not essential for the pathogenic interactions of bacteria with plants. The flagella apparatus and the TTSS are postulated to be evolved from a common origin (Gophna et al., Gene 312, 151-163, 2003); the TTSS has furthermore spread among evolutionary distant bacterial species via multiple horizontal-transfer events (Nguyen et al., J. Mol. Microbiol. Biotechnol. 2, 125-144, 2000).

Many gram-negative plant-pathogenic bacteria possess two sets of genes that modulate their interactions with plants. The avirulence genes determine host specificity based on gene-for gene interactions, and the hrp (hypersensitive reaction and pathogenicity) genes are involved in pathogenicity and the induction of hypersensitive responses (HR) in nonhost plants. The HR is a highly localized plant cell death that occurs when non-host plants or resistant cultivars of host plants are infiltrated with the plant pathogen or HR elicitor molecules, such as Avr proteins and harpins. The HR is thought be a resistance reaction of plants to microbial pathogens.

Harpins are a group of HR elicitors that are secreted by the type III secretion pathway (TTSS) and elicit HR when infiltrated into the apoplast of leaves of non-host plants. Unlike Avr proteins, which must be delivered inside the cell to exert their functions, harpins can elicit HR when delivered to the intercellular space of plant cells. Since the first harpin, HrpN, was identified from *Erwinia amylovora*, many harpins have been reported from various species, including *Pseudomonas*, *Ralstonia*, and *Xanthomonas*. Harpins are glycine-rich, heat stable proteins, lacking cysteine, and are postulated to be present in all plant pathogenic bacteria having a TTSS (Alfano and Colmer, Annu. Rev. Phytopathol. 42, 385-414, 2004). The biochemical mechanism of HR elicitation by harpins in non-host plants remains unclear. HrpZ of *Pseudomonas syringae* pv. syringae associates with the cell walls rather than the membranes of plant cells, and the protein elicits no response from protoplasts, which lack walls (Hoyos et al. Mol. Plant-Microbe Interact. 9, 608-616, 1996). However, HrpZ of *P. syringae* pv. phaseolicola binds to lipid bilayers and forms an ion-conducting pore (Lee et al., Proc. Natl. Acad. Sci. USA 98, 289-294, 2001). The N-terminal 109 amino acids and the C-terminal 216 amino acids of HrpZ are able to elicit HR to a level similar to full-length HrpZ (Alfano et al., Mol. Microbiol. 19, 715-728, 1996). Kim et al. and Charkowski et al. showed that the HrpW harpins of *E. amylovora* and *P. syringae* pv. tomato are composed of two domains—the N-terminal harpin domain and C-terminal Pel (pectate lyase) domain—and proposed that HrpW acts in the cell wall (Charkowski et al., J. Bacteriol. 180, 5211-5217, 1998; Kim and Beer, J. Bacteriol. 180, 5203-5210, 1998).

Besides harpins, the TTSS cluster in bacteria may also include genes encoding Harpin associated Factors. HpaG polypeptides are smaller than harpins, and they share little sequence homology. These sequence differences with harpins are postulated to contribute to the difference in the ability to elicit HR in plants between HpaG polypeptides and harpins (Kim et al., J. Bacteriol. 186, 6239-6247, 2004)

Korean patent application KR20030068302 discloses the *Xanthomonas* HpaG protein, which, when applied to plants or plant seeds, confers disease resistance, in particular resistance to *Xanthomonas axonopodis* infection. Harpin associated Factors have been used to confer disease resistance in plants; and as a result of this biotic stress resistance, plants had better yield compared to the control plants under biotic stress conditions.

Surprisingly it has now been found that modulating expression in a plant of a nucleic acid encoding a Harpin-associated Factor G polypeptide (HpaG) give plants enhanced yield-related traits relative to control plant. These enhanced yield-related traits were obtained in plants that were not exposed to stress.

II. SNF2

The present invention concerns a method for enhancing yield-related traits in plants relative to control plants by increasing expression in a plant of a nucleic acid sequence encoding a SWITCH 2/ SUCROSE NON-FERMENTING 2 (SWI2/SNF2) polypeptide.

Many chromosome-associated cellular processes, such as replication, transcription, DNA repair, or recombination, require accessible DNA. To deal with these events, cells possess activities that can remodel chromatin in eukaryotes or disrupt other DNA:protein complexes in both pro- and eukaryotes, using ATP hydrolysis. One of the best-studied examples of these activities is carried out by the SWI2/SNF2 family of ATPases, a large group of proteins implicated in many different remodeling-like processes.

SWI2/SNF2 family proteins are ubiquitous, as they are found in bacteria, archaea and eukaryotes. They have recently been classified into 24 distinct subfamilies, after multiple sequence alignment of the SWI2/SNF2 ATPase domain comprising the seven conserved sequence motifs (I, Ia, II, III, IV, V, and VI) (Flaus *et al.* (2006) Nucleic Acids Res. 2006; 34(10): 2887–2905). These subfamilies have traditionally taken the name of the archetypal member. One subfamily is named SSO1653, after the sole SWI2/SNF2 family member in archaeal *Sulfolobus solfataricus* (Flaus *et al.,* supra; Duur *et al.* (2005) Cell 121(3): 363-373), the uniquely archaeal and eubacterial subfamily most similar to the eukaryotic SWI2/SNF2 proteins. The SSO1653 subfamily carries all the SWI2/SNF2 family sequence and structural hallmarks.

US patent application US2003/233670 describes polynucleotides and proteins encoded by the polynucleotides. SEQ ID NO: 125 is a polynucleotide sequence encoding a SWI2/SNF2 polypeptide of the SSO1653 subfamily from *Synechocystis* sp. PCC 6803. US patent application US2005/108791 describes 24149 nucleic acid and polypeptide sequences, among which a nucleic acid sequence represented by SEQ ID NO: 57 encoding a SWI2/SNF2 polypeptide of the SSO1653 subfamily from *Synechocystis* sp. PCC 6803, as represented by SEQ ID NO: 396.

Surprisingly, it has now been found that increasing expression in a plant of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide gives plants having enhanced yield-related traits relative to control plants.

Definitions

Polypeptide(s)/Protein(s)

The terms “polypeptide” and “protein” are used interchangeably herein and refer to amino acids in a polymeric form of any length.

Polynucleotide(s)/Nucleic acid(s)/Nucleic acid sequence(s)/nucleotide sequence(s)

The terms "polynucleotide(s)", "nucleic acid sequence(s)", "nucleotide sequence(s)" are used interchangeably herein and refer to nucleotides, either ribonucleotides or deoxyribonucleotides or a combination of both, in a polymeric form of any length.

Control plant(s)

The choice of suitable control plants is a routine part of an experimental setup and may include corresponding wild type plants or corresponding plants without the gene of interest. The control plant is typically of the same plant species or even of the same variety as the plant to be assessed. The control plant may also be a nullizygote of the plant to be assessed. A “control plant” as used herein refers not only to whole plants, but also to plant parts, including seeds and seed parts.

Homologue(s)

“Homologues” of a protein encompass peptides, oligopeptides, polypeptides, proteins and enzymes having amino acid substitutions, deletions and/or insertions relative to the unmodified protein in question and having similar biological and functional activity as the unmodified protein from which they are derived.

A deletion refers to removal of one or more amino acids from a protein.

An insertion refers to one or more amino acid residues being introduced into a predetermined site in a protein. Insertions may comprise N-terminal and/or C-terminal fusions as well as intra-sequence insertions of single or multiple amino acids. Generally, insertions within the amino acid sequence will be smaller than N- or C-terminal fusions, of the order of about 1 to 10 residues. Examples of N- or C-terminal fusion proteins or peptides include the binding domain or activation domain of a transcriptional activator as used in the yeast two-hybrid system, phage coat proteins, (histidine)-6-tag, glutathione S-transferase-tag, protein A, maltose-binding protein, dihydrofolate reductase, Tag•100 epitope, c-myc epitope, FLAG®-epitope, lacZ, CMP (calmodulin-binding peptide), HA epitope, protein C epitope and VSV epitope.

A substitution refers to replacement of amino acids of the protein with other amino acids having similar properties (such as similar hydrophobicity, hydrophilicity, antigenicity, propensity to form or break α-helical structures or β-sheet structures). Amino acid substitutions are typically of single residues, but may be clustered depending upon functional constraints placed upon the polypeptide; insertions will usually be of the order of about 1 to 10 amino acid residues. The amino acid substitutions are preferably conservative amino acid substitutions. Conservative substitution tables are well known in the art (see for example Creighton (1984) Proteins. W.H. Freeman and Company and Table 1 below).

Table 1: Examples of conserved amino acid substitutions

Residue	Conservative Substitutions	Residue	Conservative Substitutions
Ala	Ser	Leu	Ile; Val
Arg	Lys	Lys	Arg; Gln
Asn	Gln; His	Met	Leu; Ile
Asp	Glu	Phe	Met; Leu; Tyr
Gln	Asn	Ser	Thr; Gly
Cys	Ser	Thr	Ser; Val
Glu	Asp	Trp	Tyr
Gly	Pro	Tyr	Trp; Phe
His	Asn; Gln	Val	Ile; Leu
Ile	Leu, Val		

Amino acid substitutions, deletions and/or insertions may readily be made using peptide synthetic techniques well known in the art, such as solid phase peptide synthesis and the like, or by recombinant DNA manipulation. Methods for the manipulation of DNA sequences to produce substitution, insertion or deletion variants of a protein are well known in the art. For example, techniques for making substitution mutations at predetermined sites in DNA are well known to those skilled in the art and include M13 mutagenesis, T7-Gen *in vitro* mutagenesis (USB, Cleveland, OH), QuickChange Site Directed mutagenesis (Stratagene, San Diego, CA), PCR-mediated site-directed mutagenesis or other site-directed mutagenesis protocols.

Derivatives

"Derivatives" include peptides, oligopeptides, polypeptides which may, compared to the amino acid sequence of the naturally-occurring form of the protein, such as the one presented in SEQ ID NO: 2, comprise substitutions of amino acids with non-naturally occurring amino acid residues, or additions of non-naturally occurring amino acid residues. "Derivatives" of a protein also encompass peptides, oligopeptides, polypeptides which comprise naturally occurring

altered (glycosylated, acylated, prenylated, phosphorylated, myristoylated, sulphated etc.) or non-naturally altered amino acid residues compared to the amino acid sequence of a naturally-occurring form of the polypeptide. A derivative may also comprise one or more non-amino acid substituents or additions compared to the amino acid sequence from which it is derived, for example a reporter molecule or other ligand, covalently or non-covalently bound to the amino acid sequence, such as a reporter molecule which is bound to facilitate its detection, and non-naturally occurring amino acid residues relative to the amino acid sequence of a naturally-occurring protein.

Orthologue(s)/Paralogue(s)

Orthologues and paralogues encompass evolutionary concepts used to describe the ancestral relationships of genes. Paralogues are genes within the same species that have originated through duplication of an ancestral gene and orthologues are genes from different organisms that have originated through speciation.

Domain

The term "domain" refers to a set of amino acids conserved at specific positions along an alignment of sequences of evolutionarily related proteins. While amino acids at other positions can vary between homologues, amino acids that are highly conserved at specific positions indicate amino acids that are likely essential in the structure, stability or activity of a protein. Identified by their high degree of conservation in aligned sequences of a family of protein homologues, they can be used as identifiers to determine if any polypeptide in question belongs to a previously identified polypeptide family.

Motif/Consensus sequence/Signature

The term “motif” or “consensus sequence” or “signature” refers to a short conserved region in the sequence of evolutionarily related proteins. Motifs are frequently highly conserved parts of domains, but may also include only part of the domain, or be located outside of conserved domain (if all of the amino acids of the motif fall outside of a defined domain).

Hybridisation

The term "hybridisation" as defined herein is a process wherein substantially homologous complementary nucleotide sequences anneal to each other. The hybridisation process can occur entirely in solution, i.e. both complementary nucleic acids are in solution. The hybridisation process can also occur with one of the complementary nucleic acids immobilised to a matrix such as magnetic beads, Sepharose beads or any other resin. The hybridisation process can furthermore occur with one of the complementary nucleic acids immobilised to a

solid support such as a nitro-cellulose or nylon membrane or immobilised by e.g. photolithography to, for example, a siliceous glass support (the latter known as nucleic acid arrays or microarrays or as nucleic acid chips). In order to allow hybridisation to occur, the nucleic acid molecules are generally thermally or chemically denatured to melt a double strand into two single strands and/or to remove hairpins or other secondary structures from single stranded nucleic acids.

The term "stringency" refers to the conditions under which a hybridisation takes place. The stringency of hybridisation is influenced by conditions such as temperature, salt concentration, ionic strength and hybridisation buffer composition. Generally, low stringency conditions are selected to be about 30°C lower than the thermal melting point (Tm) for the specific sequence at a defined ionic strength and pH. Medium stringency conditions are when the temperature is 20°C below Tm, and high stringency conditions are when the temperature is 10°C below Tm. High stringency hybridisation conditions are typically used for isolating hybridising sequences that have high sequence similarity to the target nucleic acid sequence. However, nucleic acids may deviate in sequence and still encode a substantially identical polypeptide, due to the degeneracy of the genetic code. Therefore medium stringency hybridisation conditions may sometimes be needed to identify such nucleic acid molecules.

The Tm is the temperature under defined ionic strength and pH, at which 50% of the target sequence hybridises to a perfectly matched probe. The Tm is dependent upon the solution conditions and the base composition and length of the probe. For example, longer sequences hybridise specifically at higher temperatures. The maximum rate of hybridisation is obtained from about 16°C up to 32°C below Tm. The presence of monovalent cations in the hybridisation solution reduce the electrostatic repulsion between the two nucleic acid strands thereby promoting hybrid formation; this effect is visible for sodium concentrations of up to 0.4M (for higher concentrations, this effect may be ignored). Formamide reduces the melting temperature of DNA-DNA and DNA-RNA duplexes with 0.6 to 0.7°C for each percent formamide, and addition of 50% formamide allows hybridisation to be performed at 30 to 45°C, though the rate of hybridisation will be lowered. Base pair mismatches reduce the hybridisation rate and the thermal stability of the duplexes. On average and for large probes, the Tm decreases about 1°C per % base mismatch. The Tm may be calculated using the following equations, depending on the types of hybrids:

1) DNA-DNA hybrids (Meinkoth and Wahl, Anal. Biochem., 138: 267-284, 1984):

$Tm = 81.5°C + 16.6 \times \log10[Na^+]^a + 0.41 \times \%[G/C^b] - 500 \times [L^c]^{-1} - 0.61 \times \%$ formamide

2) DNA-RNA or RNA-RNA hybrids:

Tm= 79.8 + 18.5 (log_{10}[Na^+][a]) + 0.58 (%G/C[b]) + 11.8 (%G/C[b])2 - 820/L[c]

3) oligo-DNA or oligo-RNA[d] hybrids:

For <20 nucleotides: Tm= 2 (In)

For 20–35 nucleotides: Tm= 22 + 1.46 (In)

[a] or for other monovalent cation, but only accurate in the 0.01–0.4 M range.

[b] only accurate for %GC in the 30% to 75% range.

[c] L = length of duplex in base pairs.

[d] Oligo, oligonucleotide; In, effective length of primer = 2×(no. of G/C)+(no. of A/T).

Non-specific binding may be controlled using any one of a number of known techniques such as, for example, blocking the membrane with protein containing solutions, additions of heterologous RNA, DNA, and SDS to the hybridisation buffer, and treatment with Rnase. For non-homologous probes, a series of hybridizations may be performed by varying one of (i) progressively lowering the annealing temperature (for example from 68°C to 42°C) or (ii) progressively lowering the formamide concentration (for example from 50% to 0%). The skilled artisan is aware of various parameters which may be altered during hybridisation and which will either maintain or change the stringency conditions.

Besides the hybridisation conditions, specificity of hybridisation typically also depends on the function of post-hybridisation washes. To remove background resulting from non-specific hybridisation, samples are washed with dilute salt solutions. Critical factors of such washes include the ionic strength and temperature of the final wash solution: the lower the salt concentration and the higher the wash temperature, the higher the stringency of the wash. Wash conditions are typically performed at or below hybridisation stringency. A positive hybridisation gives a signal that is at least twice of that of the background. Generally, suitable stringent conditions for nucleic acid hybridisation assays or gene amplification detection procedures are as set forth above. More or less stringent conditions may also be selected. The skilled artisan is aware of various parameters which may be altered during washing and which will either maintain or change the stringency conditions.

For example, typical high stringency hybridisation conditions for DNA hybrids longer than 50 nucleotides encompass hybridisation at 65°C in 1x SSC or at 42°C in 1x SSC and 50% formamide, followed by washing at 65°C in 0.3x SSC. Examples of medium stringency hybridisation conditions for DNA hybrids longer than 50 nucleotides encompass hybridisation at 50°C in 4x SSC or at 40°C in 6x SSC and 50% formamide, followed by washing at 50°C in 2x SSC. The length of the hybrid is the anticipated length for the hybridising nucleic acid. When nucleic acids of known sequence are hybridised, the hybrid length may be determined

by aligning the sequences and identifying the conserved regions described herein. 1×SSC is 0.15M NaCl and 15mM sodium citrate; the hybridisation solution and wash solutions may additionally include 5 × Denhardt's reagent, 0.5-1.0% SDS, 100 µg/ml denatured, fragmented salmon sperm DNA, 0.5% sodium pyrophosphate.

For the purposes of defining the level of stringency, reference can be made to Sambrook et al. (2001) Molecular Cloning: a laboratory manual, 3rd Edition Cold Spring Harbor Laboratory Press, CSH, New York or to Current Protocols in Molecular Biology, John Wiley & Sons, N.Y. (1989 and yearly updates).

Gene shuffling/Directed evolution

Gene shuffling or directed evolution consists of iterations of DNA shuffling followed by appropriate screening and/or selection to generate variants of nucleic acids or portions thereof encoding proteins having a modified biological activity (Castle et al., (2004) Science 304(5674): 1151-4; US patents 5,811,238 and 6,395,547).

Regulatory element/Control sequence/Promoter

The terms “regulatory element”, “control sequence” and “promoter” are all used interchangeably herein and are to be taken in a broad context to refer to regulatory nucleic acid sequences capable of effecting expression of the sequences to which they are ligated. The term “promoter” typically refers to a nucleic acid control sequence located upstream from the transcriptional start of a gene and which is involved in recognising and binding of RNA polymerase and other proteins, thereby directing transcription of an operably linked nucleic acid. Encompassed by the aforementioned terms are transcriptional regulatory sequences derived from a classical eukaryotic genomic gene (including the TATA box which is required for accurate transcription initiation, with or without a CCAAT box sequence) and additional regulatory elements (i.e. upstream activating sequences, enhancers and silencers) which alter gene expression in response to developmental and/or external stimuli, or in a tissue-specific manner. Also included within the term is a transcriptional regulatory sequence of a classical prokaryotic gene, in which case it may include a –35 box sequence and/or –10 box transcriptional regulatory sequences. The term “regulatory element” also encompasses a synthetic fusion molecule or derivative that confers, activates or enhances expression of a nucleic acid molecule in a cell, tissue or organ.

A “plant promoter” comprises regulatory elements, which mediate the expression of a coding sequence segment in plant cells. Accordingly, a plant promoter need not be of plant origin, but may originate from viruses or micro-organisms, for example from viruses which attack plant

cells. The "plant promoter" can also originate from a plant cell, e.g. from the plant which is transformed with the nucleic acid sequence to be expressed in the inventive process and described herein. This also applies to other "plant" regulatory signals, such as "plant" terminators. The promoters upstream of the nucleotide sequences useful in the methods of the present invention can be modified by one or more nucleotide substitution(s), insertion(s) and/or deletion(s) without interfering with the functionality or activity of either the promoters, the open reading frame (ORF) or the 3'-regulatory region such as terminators or other 3' regulatory regions which are located away from the ORF. It is furthermore possible that the activity of the promoters is increased by modification of their sequence, or that they are replaced completely by more active promoters, even promoters from heterologous organisms. For expression in plants, the nucleic acid molecule must, as described above, be linked operably to or comprise a suitable promoter which expresses the gene at the right point in time and with the required spatial expression pattern.

Operably linked

The term "operably linked" as used herein refers to a functional linkage between the promoter sequence and the gene of interest, such that the promoter sequence is able to initiate transcription of the gene of interest.

Constitutive promoter

A "constitutive promoter" refers to a promoter that is transcriptionally active during most, but not necessarily all, phases of growth and development and under most environmental conditions, in at least one cell, tissue or organ. Table 2a below gives examples of constitutive promoters.

Table 2a: Examples of constitutive promoters

Gene Source	Reference
Actin	McElroy et al, Plant Cell, 2: 163-171, 1990
HMGP	WO 2004/070039
CAMV 35S	Odell et al, Nature, 313: 810-812, 1985
CaMV 19S	Nilsson et al., Physiol. Plant. 100:456-462, 1997
GOS2	de Pater et al, Plant J Nov;2(6):837-44, 1992, WO 2004/065596
Ubiquitin	Christensen et al, Plant Mol. Biol. 18: 675-689, 1992
Rice cyclophilin	Buchholz et al, Plant Mol Biol. 25(5): 837-43, 1994
Maize H3 histone	Lepetit et al, Mol. Gen. Genet. 231:276-285, 1992
Alfalfa H3 histone	Wu et al. Plant Mol. Biol. 11:641-649, 1988
Actin 2	An et al, Plant J. 10(1); 107-121, 1996

34S FMV	Sanger et al., Plant. Mol. Biol., 14, 1990: 433-443
Rubisco small subunit	US 4,962,028
OCS	Leisner (1988) Proc Natl Acad Sci USA 85(5): 2553
SAD1	Jain et al., Crop Science, 39 (6), 1999: 1696
SAD2	Jain et al., Crop Science, 39 (6), 1999: 1696
Nos	Shaw et al. (1984) Nucleic Acids Res. 12(20):7831-7846
V-ATPase	WO 01/14572
Super promoter	WO 95/14098
G-box proteins	WO 94/12015

Ubiquitous promoter

A ubiquitous promoter is active in substantially all tissues or cells of an organism.

Developmentally-regulated promoter

A developmentally-regulated promoter is active during certain developmental stages or in parts of the plant that undergo developmental changes.

Inducible promoter

An inducible promoter has induced or increased transcription initiation in response to a chemical (for a review see Gatz 1997, Annu. Rev. Plant Physiol. Plant Mol. Biol., 48:89-108), environmental or physical stimulus, or may be “stress-inducible”, i.e. activated when a plant is exposed to various stress conditions, or a “pathogen-inducible" i.e. activated when a plant is exposed to exposure to various pathogens.

Organ-specific/Tissue-specific promoter

An organ-specific or tissue-specific promoter is one that is capable of preferentially initiating transcription in certain organs or tissues, such as the leaves, roots, seed tissue etc. For example, a “root-specific promoter” is a promoter that is transcriptionally active predominantly in plant roots, substantially to the exclusion of any other parts of a plant, whilst still allowing for any leaky expression in these other plant parts. Promoters able to initiate transcription in certain cells only are referred to herein as “cell-specific”.

Examples of root-specific promoters are listed in Table 2b below:

Table 2b: Examples of root-specific promoters

Gene Source	Reference
RCc3	Plant Mol Biol. 1995 Jan;27(2):237-48
Arabidopsis PHT1	Kovama et al., 2005; Mudge et al. (2002, Plant J. 31:341)
Medicago phosphate transporter	Xiao et al., 2006
Arabidopsis Pyk10	Nitz et al. (2001) Plant Sci 161(2): 337-346
root-expressible genes	Tingey et al., EMBO J. 6: 1, 1987.
tobacco auxin-inducible gene	Van der Zaal et al., Plant Mol. Biol. 16, 983, 1991.
β-tubulin	Oppenheimer, et al., Gene 63: 87, 1988.
tobacco root-specific genes	Conkling, et al., Plant Physiol. 93: 1203, 1990.
B. napus G1-3b gene	United States Patent No. 5, 401, 836
SbPRP1	Suzuki et al., Plant Mol. Biol. 21: 109-119, 1993.
LRX1	Baumberger et al. 2001, Genes & Dev. 15:1128
BTG-26 Brassica napus	US 20050044585
LeAMT1 (tomato)	Lauter et al. (1996, PNAS 3:8139)
The LeNRT1-1 (tomato)	Lauter et al. (1996, PNAS 3:8139)
class I patatin gene (potato)	Liu et al., Plant Mol. Biol. 153:386-395, 1991.
KDC1 (Daucus carota)	Downey et al. (2000, J. Biol. Chem. 275:39420)
TobRB7 gene	W Song (1997) PhD Thesis, North Carolina State University, Raleigh, NC USA
OsRAB5a (rice)	Wang et al. 2002, Plant Sci. 163:273
ALF5 (Arabidopsis)	Diener et al. (2001, Plant Cell 13:1625)
NRT2;1Np (N. plumbaginifolia)	Quesada et al. (1997, Plant Mol. Biol. 34:265)

A seed-specific promoter is transcriptionally active predominantly in seed tissue, but not necessarily exclusively in seed tissue (in cases of leaky expression). The seed-specific promoter may be active during seed development and/or during germination. The seed specific promoter may be endosperm and/or aleurone and/or embryo specific. Examples of seed-specific promoters (endosperm/aleurone/embryo specific) are shown in Table 2c, d, e, f below. Further examples of seed-specific promoters are given in Qing Qu and Takaiwa (Plant Biotechnol. J. 2, 113-125, 2004), which disclosure is incorporated by reference herein as if fully set forth.

Table 2c: Examples of seed-specific promoters

Gene source	Reference
seed-specific genes	Simon et al., Plant Mol. Biol. 5: 191, 1985;
	Scofield et al., J. Biol. Chem. 262: 12202, 1987.;
	Baszczynski et al., Plant Mol. Biol. 14: 633, 1990.
Brazil Nut albumin	Pearson et al., Plant Mol. Biol. 18: 235-245, 1992.
Legumin	Ellis et al., Plant Mol. Biol. 10: 203-214, 1988.
glutelin (rice)	Takaiwa et al., Mol. Gen. Genet. 208: 15-22, 1986;
	Takaiwa et al., FEBS Letts. 221: 43-47, 1987.
Zein	Matzke et al Plant Mol Biol, 14(3):323-32 1990
napA	Stalberg et al, Planta 199: 515-519, 1996.
wheat LMW and HMW glutenin-1	Mol Gen Genet 216:81-90, 1989; NAR 17:461-2, 1989
wheat SPA	Albani et al, Plant Cell, 9: 171-184, 1997
wheat α, β, γ-gliadins	EMBO J. 3:1409-15, 1984
barley ltr1 promoter	Diaz et al. (1995) Mol Gen Genet 248(5):592-8
barley B1, C, D, hordein	Theor Appl Gen 98:1253-62, 1999; Plant J 4:343-55, 1993; Mol Gen Genet 250:750-60, 1996
barley DOF	Mena et al, The Plant Journal, 116(1): 53-62, 1998
blz2	EP99106056.7
synthetic promoter	Vicente-Carbajosa et al., Plant J. 13: 629-640, 1998.
rice prolamin NRP33	Wu et al, Plant Cell Physiology 39(8) 885-889, 1998
rice a-globulin Glb-1	Wu et al, Plant Cell Physiology 39(8) 885-889, 1998
rice OSH1	Sato et al, Proc. Natl. Acad. Sci. USA, 93: 8117-8122, 1996
rice α-globulin REB/OHP-1	Nakase et al. Plant Mol. Biol. 33: 513-522, 1997
rice ADP-glucose pyrophos-phorylase	Trans Res 6:157-68, 1997
maize ESR gene family	Plant J 12:235-46, 1997
sorghum α-kafirin	DeRose et al., Plant Mol. Biol 32:1029-35, 1996
KNOX	Postma-Haarsma et al, Plant Mol. Biol. 39:257-71, 1999
rice oleosin	Wu et al, J. Biochem. 123:386, 1998
sunflower oleosin	Cummins et al., Plant Mol. Biol. 19: 873-876, 1992
PRO0117, putative rice 40S ribosomal protein	WO 2004/070039
PRO0136, rice alanine aminotransferase	unpublished

PRO0147, trypsin inhibitor ITR1 (barley)	unpublished
PRO0151, rice WSI18	WO 2004/070039
PRO0175, rice RAB21	WO 2004/070039
PRO005	WO 2004/070039
PRO0095	WO 2004/070039
α-amylase (Amy32b)	Lanahan et al, Plant Cell 4:203-211, 1992; Skriver et al, Proc Natl Acad Sci USA 88:7266-7270, 1991
cathepsin β-like gene	Cejudo et al, Plant Mol Biol 20:849-856, 1992
Barley Ltp2	Kalla et al., Plant J. 6:849-60, 1994
Chi26	Leah et al., Plant J. 4:579-89, 1994
Maize B-Peru	Selinger et al., Genetics 149;1125-38,1998

Table 2d: examples of endosperm-specific promoters

Gene source	**Reference**
glutelin (rice)	Takaiwa et al. (1986) Mol Gen Genet 208:15-22; Takaiwa et al. (1987) FEBS Letts. 221:43-47
Zein	Matzke et al., (1990) Plant Mol Biol 14(3): 323-32
wheat LMW and HMW glutenin-1	Colot et al. (1989) Mol Gen Genet 216:81-90, Anderson et al. (1989) NAR 17:461-2
wheat SPA	Albani et al. (1997) Plant Cell 9:171-184
wheat gliadins	Rafalski et al. (1984) EMBO 3:1409-15
barley ltr1 promoter	Diaz et al. (1995) Mol Gen Genet 248(5):592-8
barley B1, C, D, hordein	Cho et al. (1999) Theor Appl Genet 98:1253-62; Muller et al. (1993) Plant J 4:343-55; Sorenson et al. (1996) Mol Gen Genet 250:750-60
barley DOF	Mena et al, (1998) Plant J 116(1): 53-62
blz2	Onate et al. (1999) J Biol Chem 274(14):9175-82
Synthetic promoter	Vicente-Carbajosa et al. (1998) Plant J 13:629-640
rice prolamin NRP33	Wu et al, (1998) Plant Cell Physiol 39(8) 885-889
rice globulin Glb-1	Wu et al. (1998) Plant Cell Physiol 39(8) 885-889
rice globulin REB/OHP-1	Nakase et al. (1997) Plant Molec Biol 33: 513-522
rice ADP-glucose pyrophosphorylase	Russell et al. (1997) Trans Res 6:157-68
maize ESR gene family	Opsahl-Ferstad et al. (1997) Plant J 12:235-46
Sorghum kafirin	DeRose et al. (1996) Plant Mol Biol 32:1029-35

Table 2e: Examples of embryo specific promoters:

Gene source	Reference
rice OSH1	Sato et al, Proc. Natl. Acad. Sci. USA, 93: 8117-8122, 1996
KNOX	Postma-Haarsma et al, Plant Mol. Biol. 39:257-71, 1999
PRO0151	WO 2004/070039
PRO0175	WO 2004/070039
PRO005	WO 2004/070039
PRO0095	WO 2004/070039

Table 2f: Examples of aleurone-specific promoters:

Gene source	Reference
α-amylase (Amy32b)	Lanahan et al, Plant Cell 4:203-211, 1992; Skriver et al, Proc Natl Acad Sci USA 88:7266-7270, 1991
Cathepsin β-like gene	Cejudo et al, Plant Mol Biol 20:849-856, 1992
Barley Ltp2	Kalla et al., Plant J. 6:849-60, 1994
Chi26	Leah et al., Plant J. 4:579-89, 1994
Maize B-Peru	Selinger et al., Genetics 149;1125-38,1998

A green tissue-specific promoter as defined herein is a promoter that is transcriptionally active predominantly in green tissue, substantially to the exclusion of any other parts of a plant, whilst still allowing for any leaky expression in these other plant parts.

Examples of green tissue-specific promoters which may be used to perform the methods of the invention are shown in Table 2g below.

Table 2g: Examples of green tissue-specific promoters

Gene	Expression	Reference
Maize Orthophosphate dikinase	Leaf specific	Fukavama et al., 2001
Maize Phosphoenolpyruvate carboxylase	Leaf specific	Kausch et al., 2001
Rice Phosphoenolpyruvate carboxylase	Leaf specific	Liu et al., 2003
Rice small subunit Rubisco	Leaf specific	Nomura et al., 2000
rice beta expansin EXBP9	Shoot specific	WO 2004/070039
Pigeonpea small subunit Rubisco	Leaf specific	Panguluri et al., 2005
Pea RBCS3A	Leaf specific	

Another example of a tissue-specific promoter is a meristem-specific promoter, which is transcriptionally active predominantly in meristematic tissue, substantially to the exclusion of

any other parts of a plant, whilst still allowing for any leaky expression in these other plant parts. Examples of green meristem-specific promoters which may be used to perform the methods of the invention are shown in Table 2h below.

Table 2h: Examples of meristem-specific promoters

Gene source	Expression pattern	Reference
rice OSH1	Shoot apical meristem, from embryo globular stage to seedling stage	Sato *et al.* (1996) Proc. Natl. Acad. Sci. USA, 93: 8117-8122
Rice metallothionein	Meristem specific	BAD87835.1
WAK1 & WAK 2	Shoot and root apical meristems, and in expanding leaves and sepals	Wagner & Kohorn (2001) Plant Cell 13(2): 303–318

Terminator

The term "terminator" encompasses a control sequence which is a DNA sequence at the end of a transcriptional unit which signals 3' processing and polyadenylation of a primary transcript and termination of transcription. The terminator can be derived from the natural gene, from a variety of other plant genes, or from T-DNA. The terminator to be added may be derived from, for example, the nopaline synthase or octopine synthase genes, or alternatively from another plant gene, or less preferably from any other eukaryotic gene.

Selectable marker (gene)/Reporter gene

"Selectable marker", "selectable marker gene" or "reporter gene" includes any gene that confers a phenotype on a cell in which it is expressed to facilitate the identification and/or selection of cells that are transfected or transformed with a nucleic acid construct of the invention. These marker genes enable the identification of a successful transfer of the nucleic acid molecules via a series of different principles. Suitable markers may be selected from markers that confer antibiotic or herbicide resistance, that introduce a new metabolic trait or that allow visual selection. Examples of selectable marker genes include genes conferring resistance to antibiotics (such as nptII that phosphorylates neomycin and kanamycin, or hpt, phosphorylating hygromycin, or genes conferring resistance to, for example, bleomycin, streptomycin, tetracyclin, chloramphenicol, ampicillin, gentamycin, geneticin (G418), spectinomycin or blasticidin), to herbicides (for example bar which provides resistance to Basta®; aroA or gox providing resistance against glyphosate, or the genes conferring resistance to, for example, imidazolinone, phosphinothricin or sulfonylurea), or genes that provide a metabolic trait (such as manA that allows plants to use mannose as sole carbon

source or xylose isomerase for the utilisation of xylose, or antinutritive markers such as the resistance to 2-deoxyglucose). Expression of visual marker genes results in the formation of colour (for example β-glucuronidase, GUS or β-galactosidase with its coloured substrates, for example X-Gal), luminescence (such as the luciferin/luceferase system) or fluorescence (Green Fluorescent Protein, GFP, and derivatives thereof). This list represents only a small number of possible markers. The skilled worker is familiar with such markers. Different markers are preferred, depending on the organism and the selection method.

Transgenic/Transgene/Recombinant

For the purposes of the invention, "transgenic", “transgene” or "recombinant" means with regard to, for example, a nucleic acid sequence, an expression cassette, gene construct or a vector comprising the nucleic acid sequence or an organism transformed with the nucleic acid sequences, expression cassettes or vectors according to the invention, all those constructions brought about by recombinant methods in which either

(a) the nucleic acid sequences encoding proteins useful in the methods of the invention, or

(b) genetic control sequence(s) which is operably linked with the nucleic acid sequence according to the invention, for example a promoter, or

(c) a) and b)

are not located in their natural genetic environment or have been modified by recombinant methods, it being possible for the modification to take the form of, for example, a substitution, addition, deletion, inversion or insertion of one or more nucleotide residues. The natural genetic environment is understood as meaning the natural genomic or chromosomal locus in the original plant or the presence in a genomic library. In the case of a genomic library, the natural genetic environment of the nucleic acid sequence is preferably retained, at least in part. The environment flanks the nucleic acid sequence at least on one side and has a sequence length of at least 50 bp, preferably at least 500 bp, especially preferably at least 1000 bp, most preferably at least 5000 bp. A naturally occurring expression cassette – for example the naturally occurring combination of the natural promoter of the nucleic acid sequences with the corresponding nucleic acid sequence encoding a polypeptide useful in the methods of the present invention, as defined above – becomes a transgenic expression cassette when this expression cassette is modified by non-natural, synthetic ("artificial") methods such as, for example, mutagenic treatment. Suitable methods are described, for example, in US 5,565,350 or WO 00/15815.

A transgenic plant for the purposes of the invention is thus understood as meaning, as above, that the nucleic acids used in the method of the invention are not at their natural locus in the genome of said plant, it being possible for the nucleic acids to be expressed homologously or

heterologously. However, as mentioned, transgenic also means that, while the nucleic acids according to the invention or used in the inventive method are at their natural position in the genome of a plant, the sequence has been modified with regard to the natural sequence, and/or that the regulatory sequences of the natural sequences have been modified. Transgenic is preferably understood as meaning the expression of the nucleic acids according to the invention at an unnatural locus in the genome, i.e. homologous or, preferably, heterologous expression of the nucleic acids takes place. Preferred transgenic plants are mentioned herein.

Transformation

The term "introduction" or "transformation" as referred to herein encompasses the transfer of an exogenous polynucleotide into a host cell, irrespective of the method used for transfer. Plant tissue capable of subsequent clonal propagation, whether by organogenesis or embryogenesis, may be transformed with a genetic construct of the present invention and a whole plant regenerated there from. The particular tissue chosen will vary depending on the clonal propagation systems available for, and best suited to, the particular species being transformed. Exemplary tissue targets include leaf disks, pollen, embryos, cotyledons, hypocotyls, megagametophytes, callus tissue, existing meristematic tissue (e.g., apical meristem, axillary buds, and root meristems), and induced meristem tissue (e.g., cotyledon meristem and hypocotyl meristem). The polynucleotide may be transiently or stably introduced into a host cell and may be maintained non-integrated, for example, as a plasmid. Alternatively, it may be integrated into the host genome. The resulting transformed plant cell may then be used to regenerate a transformed plant in a manner known to persons skilled in the art.

The transfer of foreign genes into the genome of a plant is called transformation. Transformation of plant species is now a fairly routine technique. Advantageously, any of several transformation methods may be used to introduce the gene of interest into a suitable ancestor cell. The methods described for the transformation and regeneration of plants from plant tissues or plant cells may be utilized for transient or for stable transformation. Transformation methods include the use of liposomes, electroporation, chemicals that increase free DNA uptake, injection of the DNA directly into the plant, particle gun bombardment, transformation using viruses or pollen and microprojection. Methods may be selected from the calcium/polyethylene glycol method for protoplasts (Krens, F.A. et al., (1982) Nature 296, 72-74; Negrutiu I et al. (1987) Plant Mol Biol 8: 363-373); electroporation of protoplasts (Shillito R.D. et al. (1985) Bio/Technol 3, 1099-1102); microinjection into plant material (Crossway A et al., (1986) Mol. Gen Genet 202: 179-185); DNA or RNA-coated particle bombardment (Klein

TM et al., (1987) Nature 327: 70) infection with (non-integrative) viruses and the like. Transgenic plants, including transgenic crop plants, are preferably produced via Agrobacterium-mediated transformation. An advantageous transformation method is the transformation in planta. To this end, it is possible, for example, to allow the agrobacteria to act on plant seeds or to inoculate the plant meristem with agrobacteria. It has proved particularly expedient in accordance with the invention to allow a suspension of transformed agrobacteria to act on the intact plant or at least on the flower primordia. The plant is subsequently grown on until the seeds of the treated plant are obtained (Clough and Bent, Plant J. (1998) 16, 735–743). Methods for Agrobacterium-mediated transformation of rice include well known methods for rice transformation, such as those described in any of the following: European patent application EP 1198985 A1, Aldemita and Hodges (Planta 199: 612-617, 1996); Chan et al. (Plant Mol Biol 22 (3): 491-506, 1993), Hiei et al. (Plant J 6 (2): 271-282, 1994), which disclosures are incorporated by reference herein as if fully set forth. In the case of corn transformation, the preferred method is as described in either Ishida et al. (Nat. Biotechnol 14(6): 745-50, 1996) or Frame et al. (Plant Physiol 129(1): 13-22, 2002), which disclosures are incorporated by reference herein as if fully set forth. Said methods are further described by way of example in B. Jenes et al., Techniques for Gene Transfer, in: Transgenic Plants, Vol. 1, Engineering and Utilization, eds. S.D. Kung and R. Wu, Academic Press (1993) 128-143 and in Potrykus Annu. Rev. Plant Physiol. Plant Molec. Biol. 42 (1991) 205-225). The nucleic acids or the construct to be expressed is preferably cloned into a vector, which is suitable for transforming Agrobacterium tumefaciens, for example pBin19 (Bevan et al., Nucl. Acids Res. 12 (1984) 8711). Agrobacteria transformed by such a vector can then be used in known manner for the transformation of plants, such as plants used as a model, like Arabidopsis (Arabidopsis thaliana is within the scope of the present invention not considered as a crop plant), or crop plants such as, by way of example, tobacco plants, for example by immersing bruised leaves or chopped leaves in an agrobacterial solution and then culturing them in suitable media. The transformation of plants by means of Agrobacterium tumefaciens is described, for example, by Höfgen and Willmitzer in Nucl. Acid Res. (1988) 16, 9877 or is known inter alia from F.F. White, Vectors for Gene Transfer in Higher Plants; in Transgenic Plants, Vol. 1, Engineering and Utilization, eds. S.D. Kung and R. Wu, Academic Press, 1993, pp. 15-38.

In addition to the transformation of somatic cells, which then have to be regenerated into intact plants, it is also possible to transform the cells of plant meristems and in particular those cells which develop into gametes. In this case, the transformed gametes follow the natural plant development, giving rise to transgenic plants. Thus, for example, seeds of Arabidopsis are treated with agrobacteria and seeds are obtained from the developing plants of which a certain

proportion is transformed and thus transgenic [Feldman, KA and Marks MD (1987). Mol Gen Genet 208:274-289; Feldmann K (1992). In: C Koncz, N-H Chua and J Shell, eds, Methods in Arabidopsis Research. Word Scientific, Singapore, pp. 274-289]. Alternative methods are based on the repeated removal of the inflorescences and incubation of the excision site in the center of the rosette with transformed agrobacteria, whereby transformed seeds can likewise be obtained at a later point in time (Chang (1994). Plant J. 5: 551-558; Katavic (1994). Mol Gen Genet, 245: 363-370). However, an especially effective method is the vacuum infiltration method with its modifications such as the "floral dip" method. In the case of vacuum infiltration of Arabidopsis, intact plants under reduced pressure are treated with an agrobacterial suspension [Bechthold, N (1993). C R Acad Sci Paris Life Sci, 316: 1194-1199], while in the case of the"floral dip" method the developing floral tissue is incubated briefly with a surfactant-treated agrobacterial suspension [Clough, SJ und Bent, AF (1998). The Plant J. 16, 735-743]. A certain proportion of transgenic seeds are harvested in both cases, and these seeds can be distinguished from non-transgenic seeds by growing under the above-described selective conditions. In addition the stable transformation of plastids is of advantages because plastids are inherited maternally is most crops reducing or eliminating the risk of transgene flow through pollen. The transformation of the chloroplast genome is generally achieved by a process which has been schematically displayed in Klaus et al., 2004 [Nature Biotechnology 22 (2), 225-229]. Briefly the sequences to be transformed are cloned together with a selectable marker gene between flanking sequences homologous to the chloroplast genome. These homologous flanking sequences direct site specific integration into the plastome. Plastidal transformation has been described for many different plant species and an overview is given in Bock (2001) Transgenic plastids in basic research and plant biotechnology. J Mol Biol. 2001 Sep 21; 312 (3):425-38 or Maliga, P (2003) Progress towards commercialization of plastid transformation technology. Trends Biotechnol. 21, 20-28. Further biotechnological progress has recently been reported in form of marker free plastid transformants, which can be produced by a transient co-integrated maker gene (Klaus et al., 2004, Nature Biotechnology 22(2), 225-229).

TILLING

TILLING (Targeted Induced Local Lesions In Genomes) is a mutagenesis technology useful to generate and/or identify nucleic acids encoding proteins with modified expression and/or activity. TILLING also allows selection of plants carrying such mutant variants. These mutant variants may exhibit modified expression, either in strength or in location or in timing (if the mutations affect the promoter for example). These mutant variants may exhibit higher activity than that exhibited by the gene in its natural form. TILLING combines high-density mutagenesis with high-throughput screening methods. The steps typically followed in TILLING

are: (a) EMS mutagenesis (Redei GP and Koncz C (1992) In Methods in Arabidopsis Research, Koncz C, Chua NH, Schell J, eds. Singapore, World Scientific Publishing Co, pp. 16–82; Feldmann et al., (1994) In Meyerowitz EM, Somerville CR, eds, Arabidopsis. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, pp 137-172; Lightner J and Caspar T (1998) In J Martinez-Zapater, J Salinas, eds, Methods on Molecular Biology, Vol. 82. Humana Press, Totowa, NJ, pp 91-104); (b) DNA preparation and pooling of individuals; (c) PCR amplification of a region of interest; (d) denaturation and annealing to allow formation of heteroduplexes; (e) DHPLC, where the presence of a heteroduplex in a pool is detected as an extra peak in the chromatogram; (f) identification of the mutant individual; and (g) sequencing of the mutant PCR product. Methods for TILLING are well known in the art (McCallum et al., (2000) Nat Biotechnol 18: 455-457; reviewed by Stemple (2004) Nat Rev Genet 5(2): 145-50).

Yield

The term "yield" in general means a measurable produce of economic value, typically related to a specified crop, to an area, and to a period of time. Individual plant parts directly contribute to yield based on their number, size and/or weight, or the actual yield is the yield per acre for a crop and year, which is determined by dividing total production (includes both harvested and appraised production) by planted acres.

Increase/Improve/Enhance

The terms "increase", "improve" or "enhance" are interchangeable and shall mean in the sense of the application at least a 5%, 6%, 7%, 8%, 9% or 10%, preferably at least 15% or 20%, more preferably 25%, 30%, 35% or 40% more yield and/or growth in comparison to control plants as defined herein.

Seed yield

Increased seed yield may manifest itself as one or more of the following: a) an increase in seed biomass (total seed weight) which may be on an individual seed basis and/or per plant and/or per hectare or acre; b) increased number of flowers per plant; c) increased number of (filled) seeds; d) increased seed filling rate (which is expressed as the ratio between the number of filled seeds divided by the total number of seeds); e) increased harvest index, which is expressed as a ratio of the yield of harvestable parts, such as seeds, divided by the total biomass; and f) increased thousand kernel weight (TKW), which is extrapolated from the number of filled seeds counted and their total weight. An increased TKW may result from an increased seed size and/or seed weight, and may also result from an increase in embryo and/or endosperm size.

An increase in seed yield may also be manifested as an increase in seed size and/or seed volume. Furthermore, an increase in seed yield may also manifest itself as an increase in seed area and/or seed length and/or seed width and/or seed perimeter. Increased yield may also result in modified architecture, or may occur because of modified architecture.

Plant

The term "plant" as used herein encompasses whole plants, ancestors and progeny of the plants and plant parts, including seeds, shoots, stems, leaves, roots (including tubers), flowers, and tissues and organs, wherein each of the aforementioned comprise the gene/nucleic acid of interest. The term "plant" also encompasses plant cells, suspension cultures, callus tissue, embryos, meristematic regions, gametophytes, sporophytes, pollen and microspores, again wherein each of the aforementioned comprises the gene/nucleic acid of interest.

Plants that are particularly useful in the methods of the invention include all plants which belong to the superfamily Viridiplantae, in particular monocotyledonous and dicotyledonous plants including fodder or forage legumes, ornamental plants, food crops, trees or shrubs selected from the list comprising *Acer* spp., *Actinidia* spp., *Abelmoschus* spp., *Agave sisalana, Agropyron* spp., *Agrostis stolonifera, Allium* spp., *Amaranthus* spp., *Ammophila arenaria, Ananas comosus, Annona* spp., *Apium graveolens, Arachis spp, Artocarpus* spp., *Asparagus officinalis, Avena* spp. *(e.g. Avena sativa, Avena fatua, Avena byzantina, Avena fatua var. sativa, Avena hybrida), Averrhoa carambola, Bambusa sp., Benincasa hispida, Bertholletia excelsea, Beta vulgaris, Brassica* spp. *(e.g. Brassica napus, Brassica rapa* ssp. [canola, oilseed rape, turnip rape]), *Cadaba farinosa, Camellia sinensis, Canna indica, Cannabis sativa, Capsicum* spp., *Carex elata, Carica papaya, Carissa macrocarpa, Carya* spp., *Carthamus tinctorius, Castanea* spp., *Ceiba pentandra, Cichorium endivia, Cinnamomum* spp., *Citrullus lanatus, Citrus* spp., *Cocos* spp., *Coffea* spp., *Colocasia esculenta, Cola* spp., *Corchorus sp., Coriandrum sativum, Corylus* spp., *Crataegus* spp., *Crocus sativus, Cucurbita* spp., *Cucumis* spp., *Cynara* spp., *Daucus carota, Desmodium* spp., *Dimocarpus longan, Dioscorea* spp., *Diospyros* spp., *Echinochloa* spp., *Elaeis (e.g. Elaeis guineensis, Elaeis oleifera), Eleusine coracana, Erianthus sp., Eriobotrya japonica, Eucalyptus sp., Eugenia uniflora, Fagopyrum* spp., *Fagus* spp., *Festuca arundinacea, Ficus carica, Fortunella* spp., *Fragaria* spp., *Ginkgo biloba, Glycine* spp. *(e.g. Glycine max, Soja hispida or Soja max), Gossypium hirsutum, Helianthus* spp. *(e.g. Helianthus annuus), Hemerocallis fulva, Hibiscus* spp., *Hordeum* spp. *(e.g. Hordeum vulgare), Ipomoea batatas, Juglans* spp., *Lactuca sativa, Lathyrus* spp., *Lens culinaris, Linum usitatissimum, Litchi chinensis, Lotus* spp., *Luffa acutangula, Lupinus* spp., *Luzula sylvatica, Lycopersicon* spp. *(e.g. Lycopersicon esculentum, Lycopersicon lycopersicum, Lycopersicon pyriforme), Macrotyloma* spp., *Malus* spp., *Malpighia emarginata,*

Mammea americana, Mangifera indica, Manihot spp., *Manilkara zapota, Medicago sativa, Melilotus* spp., *Mentha* spp., *Miscanthus sinensis, Momordica* spp., *Morus nigra, Musa* spp., *Nicotiana* spp., *Olea* spp., *Opuntia* spp., *Ornithopus* spp., *Oryza* spp. *(e.g. Oryza sativa, Oryza latifolia), Panicum miliaceum, Panicum virgatum, Passiflora edulis, Pastinaca sativa, Pennisetum sp., Persea* spp., *Petroselinum crispum, Phalaris arundinacea, Phaseolus* spp., *Phleum pratense, Phoenix* spp., *Phragmites australis, Physalis* spp., *Pinus* spp., *Pistacia vera, Pisum* spp., *Poa* spp., *Populus* spp., *Prosopis* spp., *Prunus* spp., *Psidium* spp., *Punica granatum, Pyrus communis, Quercus* spp., *Raphanus sativus, Rheum rhabarbarum, Ribes* spp., *Ricinus communis, Rubus* spp., *Saccharum* spp., *Salix sp., Sambucus* spp., *Secale cereale, Sesamum* spp., *Sinapis sp., Solanum* spp. *(e.g. Solanum tuberosum, Solanum integrifolium or Solanum lycopersicum), Sorghum bicolor, Spinacia* spp., *Syzygium* spp., *Tagetes* spp., *Tamarindus indica, Theobroma cacao, Trifolium* spp., *Triticosecale rimpaui, Triticum* spp. *(e.g. Triticum aestivum, Triticum durum, Triticum turgidum, Triticum hybernum, Triticum macha, Triticum sativum or Triticum vulgare), Tropaeolum minus, Tropaeolum majus, Vaccinium* spp., *Vicia* spp., *Vigna* spp., *Viola odorata, Vitis* spp., *Zea mays, Zizania palustris, Ziziphus* spp., amongst others.

Detailed description of the invention

I. HARPIN

According to a first embodiment, the present invention provides a method for enhancing yield-related traits in plants, comprising modulating expression in a plant of a nucleic acid encoding a Harpin-associated Factor G (hereinafter termed “HpaG”) polypeptide.

A preferred method for modulating (preferably, increasing) expression of a nucleic acid encoding an HpaG polypeptide is by introducing and expressing in a plant a nucleic acid encoding an HpaG polypeptide.

Any reference hereinafter to a “protein useful in the methods of the invention” is taken to mean an HpaG polypeptide as defined herein. Any reference hereinafter to a “nucleic acid useful in the methods of the invention” is taken to mean a nucleic acid capable of encoding such an HpaG polypeptide. The nucleic acid to be introduced into a plant (and therefore useful in performing the methods of the invention) is any nucleic acid encoding the type of protein which will now be described, hereafter also named “*HpaG* nucleic acid” or “*HpaG* gene”.

An HpaG polypeptide as defined herein comprises any polypeptide having the following features:

(i) in increasing order of preference, at least 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95% or more sequence identity to the HpaG polypeptide sequence represented by SEQ ID NO: 2; and

(ii) an amino acid composition wherein the glycine content ranges from between about 13% and about 25%, the glutamine content ranges from between about 13% and about 20%, the cysteine content ranges from between about 0% and about 1%, the histidine content ranges from between about 0% and about 1%, and wherein tryptophan is absent.

Preferably, the length of the HpaG polypeptide ranges between about 121 and about 143 amino acids.

Preferably, the HpaG protein also comprises the conserved motif 1 (SEQ ID NO: 3)
G(G/E/D)(N/E)X(Q/R/P)Q(A/S)GX(N/D)G
wherein X on position 4 may be any amino acid, preferably one of S, N, P, R, or Q, and wherein X on position 9 may be any amino acid, preferably one of Q, E, S, or P; and/or the conserved motif 2 (SEQ ID NO: 4)
(P/A/V)S(P/Q/A)(F/L/Y)TQ(M/A)LM(H/N/Q)IV(G/M)(E/D/Q)

Optionally, the HpaG protein also has the conserved motif 3:
QGISEKQLDQLL
And/or the conserved motif 4:
ILQAQN

Furthermore, HpaG polypeptides (at least in their native form) elicit a hypersensitive response in Arabidopsis thaliana ecotype Cvi-0 (Kim et al., J. Bacteriol. 185, 3155-3166, 2003).

Alternatively, the homologue of a HpaG protein has in increasing order of preference at least 25%, 26%, 27%, 28%, 29%, 30%, 31%, 32%, 33%, 34%, 35%, 36%, 37%, 38%, 39%, 40%, 41%, 42%, 43%, 44%, 45%, 46%, 47%, 48%, 49%, 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, 60%, 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, 70%, 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, or 99% overall sequence identity to the amino acid represented by SEQ ID NO: 2, provided that the homologous protein comprises the conserved motifs as outlined above. The overall sequence identity is determined using a global alignment algorithm, such as the Needleman Wunsch algorithm in the program GAP (GCG Wisconsin Package, Accelrys), preferably with default parameters. Compared to overall

sequence identity, the sequence identity will generally be higher when only conserved domains or motifs are considered.

The term "domain" and "motif" is as defined in the "definitions" section herein. Specialist databases exist for the identification of domains, for example, SMART (Schultz et al. (1998) Proc. Natl. Acad. Sci. USA 95, 5857-5864; Letunic et al. (2002) Nucleic Acids Res 30, 242-244, InterPro (Mulder et al., (2003) Nucl. Acids. Res. 31, 315-318, Prosite (Bucher and Bairoch (1994), A generalized profile syntax for biomolecular sequences motifs and its function in automatic sequence interpretation. (In) ISMB-94; Proceedings 2nd International Conference on Intelligent Systems for Molecular Biology. Altman R., Brutlag D., Karp P., Lathrop R., Searls D., Eds., pp53-61, AAAIPress, Menlo Park; Hulo et al., Nucl. Acids. Res. 32:D134-D137, (2004), or Pfam (Bateman et al., Nucleic Acids Research 30(1): 276-280 (2002). A set of tools for *in silico* analysis of protein sequences is available on the ExPASY proteomics server (hosted by the Swiss Institute of Bioinformatics (Gasteiger et al., ExPASy: the proteomics server for in-depth protein knowledge and analysis, Nucleic Acids Res. 31:3784-3788(2003)). Domains may also be identified using routine techniques, such as by sequence alignment.

Methods for the alignment of sequences for comparison are well known in the art, such methods include GAP, BESTFIT, BLAST, FASTA and TFASTA. GAP uses the algorithm of Needleman and Wunsch ((1970) J Mol Biol 48: 443-453) to find the global (i.e. spanning the complete sequences) alignment of two sequences that maximizes the number of matches and minimizes the number of gaps. The BLAST algorithm (Altschul et al. (1990) J Mol Biol 215: 403-10) calculates percent sequence identity and performs a statistical analysis of the similarity between the two sequences. The software for performing BLAST analysis is publicly available through the National Centre for Biotechnology Information (NCBI). Homologues may readily be identified using, for example, the ClustalW multiple sequence alignment algorithm (version 1.83), with the default pairwise alignment parameters, and a scoring method in percentage. Global percentages of similarity and identity may also be determined using one of the methods available in the MatGAT software package (Campanella et al., BMC Bioinformatics. 2003 Jul 10;4:29. MatGAT: an application that generates similarity/identity matrices using protein or DNA sequences.). Minor manual editing may be performed to optimise alignment between conserved motifs, as would be apparent to a person skilled in the art. Furthermore, instead of using full-length sequences for the identification of homologues, specific domains may also be used. The sequence identity values may be determined over the entire nucleic acid or amino acid sequence or over selected domains or conserved motif(s), using the programs mentioned above using the default parameters.

The present invention is illustrated by transforming plants with the nucleic acid sequence represented by SEQ ID NO: 1, encoding the polypeptide sequence of SEQ ID NO: 2. However, performance of the invention is not restricted to these sequences; the methods of the invention may advantageously be performed using any HpaG-encoding nucleic acid or HpaG-like polypeptide as defined herein.

Examples of nucleic acids encoding HpaG polypeptides are given in Table A of Example 1 herein. Such nucleic acids are useful in performing the methods of the invention. The amino acid sequences given in Table A of Example 1 are example sequences of orthologues and paralogues of the HpaG polypeptide represented by SEQ ID NO: 2, the terms "orthologues" and "paralogues" being as defined herein. Further orthologues and paralogues may readily be identified by performing a so-called reciprocal blast search. Typically, this involves a first BLAST involving BLASTing a query sequence (for example using any of the sequences listed in Table A of Example 1) against any sequence database, such as the publicly available NCBI database. BLASTN or TBLASTX (using standard default values) are generally used when starting from a nucleotide sequence, and BLASTP or TBLASTN (using standard default values) when starting from a protein sequence. The BLAST results may optionally be filtered. The full-length sequences of either the filtered results or non-filtered results are then BLASTed back (second BLAST) against sequences from the organism from which the query sequence is derived (where the query sequence is SEQ ID NO: 1 or SEQ ID NO: 2, the second BLAST would therefore be against *Xanthomonas* sequences). The results of the first and second BLASTs are then compared. A paralogue is identified if a high-ranking hit from the first blast is from the same species as from which the query sequence is derived, a BLAST back then ideally results in the query sequence amongst the highest hits; an orthologue is identified if a high-ranking hit in the first BLAST is not from the same species as from which the query sequence is derived, and preferably results upon BLAST back in the query sequence being among the highest hits.

High-ranking hits are those having a low E-value. The lower the E-value, the more significant the score (or in other words the lower the chance that the hit was found by chance). Computation of the E-value is well known in the art. In addition to E-values, comparisons are also scored by percentage identity. Percentage identity refers to the number of identical nucleotides (or amino acids) between the two compared nucleic acid (or polypeptide) sequences over a particular length. In the case of large families, ClustalW may be used, followed by a neighbour joining tree, to help visualize clustering of related genes and to identify orthologues and paralogues.

Nucleic acid variants may also be useful in practising the methods of the invention. Examples of such variants include nucleic acids encoding homologues and derivatives of any one of the amino acid sequences given in Table A of Example 1, the terms "homologue" and "derivative" being as defined herein. Also useful in the methods of the invention are nucleic acids encoding homologues and derivatives of orthologues or paralogues of any one of the amino acid sequences given in Table A of Example 1. Homologues and derivatives useful in the methods of the present invention have substantially the same biological and functional activity as the unmodified protein from which they are derived.

Further nucleic acid variants useful in practising the methods of the invention include portions of nucleic acids encoding HpaG polypeptides, nucleic acids hybridising to nucleic acids encoding HpaG polypeptides, and variants of nucleic acids encoding HpaG polypeptides obtained by gene shuffling. The terms hybridising sequence, and gene shuffling are as described herein.

Nucleic acids encoding HpaG polypeptides need not be full-length nucleic acids, since performance of the methods of the invention does not rely on the use of full-length nucleic acid sequences. According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant a portion of any one of the nucleic acid sequences given in Table A of Example 1, or a portion of a nucleic acid encoding an orthologue, paralogue or homologue of any of the amino acid sequences given in Table A of Example 1.

A portion of a nucleic acid may be prepared, for example, by making one or more deletions to the nucleic acid. The portions may be used in isolated form or they may be fused to other coding (or non-coding) sequences in order to, for example, produce a protein that combines several activities. When fused to other coding sequences, the resultant polypeptide produced upon translation may be bigger than that predicted for the protein portion.

Portions useful in the methods of the invention, encode an HpaG polypeptide as defined herein, and have substantially the same biological activity as the amino acid sequences given in Table A of Example 1. Preferably, the portion is a portion of any one of the nucleic acids given in Table A of Example 1, or is a portion of a nucleic acid encoding an orthologue or paralogue of any one of the amino acid sequences given in Table A of Example 1. Preferably the portion is, in increasing order of preference at least 70, 90, 110, 130 consecutive nucleotides in length, the consecutive nucleotides being of any one of the nucleic acid sequences given in Table A of Example 1, or of a nucleic acid encoding an orthologue or

paralogue of any one of the amino acid sequences given in Table A of Example 1. Most preferably the portion is a portion of the nucleic acid of SEQ ID NO: 1. Preferably, the portion encodes an amino acid sequence which when used in the construction of a phylogenetic tree, such as the one depicted in Figure. 2, tends to cluster with the group of HpaG polypeptides comprising the amino acid sequence represented by SEQ ID NO: 2 rather than with any other group.

Another nucleic acid variant useful in the methods of the invention is a nucleic acid capable of hybridising, under reduced stringency conditions, preferably under stringent conditions, with a nucleic acid encoding an HpaG polypeptide as defined herein, or with a portion as defined herein.

According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant a nucleic acid capable of hybridizing to any one of the nucleic acids given in Table A of Example 1, or comprising introducing and expressing in a plant a nucleic acid capable of hybridising to a nucleic acid encoding an orthologue, paralogue or homologue of any of the nucleic acid sequences given in Table A of Example 1.

Hybridising sequences useful in the methods of the invention encode an HpaG polypeptide as defined herein, and have substantially the same biological activity as the amino acid sequences given in Table A of Example 1. Preferably, the hybridising sequence is capable of hybridising to any one of the nucleic acids given in Table A of Example 1, or to a portion of any of these sequences, a portion being as defined above, or wherein the hybridising sequence is capable of hybridising to a nucleic acid encoding an orthologue or paralogue of any one of the amino acid sequences given in Table A of Example 1. Most preferably, the hybridising sequence is capable of hybridising to a nucleic acid as represented by SEQ ID NO: 1 or to a portion thereof.

Preferably, the hybridising sequence encodes an amino acid sequence which when used in the construction of a phylogenetic tree, such as the one depicted in Figure 2, tends to cluster with the group of HpaG polypeptides comprising the amino acid sequence represented by SEQ ID NO: 2 rather than with any other group.

Gene shuffling or directed evolution may also be used to generate variants of nucleic acids encoding HpaG polypeptides as defined above; the term “gene shuffling” being as defined herein.

According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant a variant of any one of the nucleic acid sequences given in Table A of Example 1, or comprising introducing and expressing in a plant a variant of a nucleic acid encoding an orthologue, paralogue or homologue of any of the amino acid sequences given in Table A of Example 1, which variant nucleic acid is obtained by gene shuffling.

Preferably, the amino acid sequence encoded by the variant nucleic acid obtained by gene shuffling, when used in the construction of a phylogenetic tree such as the one depicted in Figure 2, tends to cluster with the group of HpaG polypeptides comprising the amino acid sequence represented by SEQ ID NO: 2 rather than with any other group.

Furthermore, nucleic acid variants may also be obtained by site-directed mutagenesis. Several methods are available to achieve site-directed mutagenesis, the most common being PCR based methods (Current Protocols in Molecular Biology. Wiley Eds.).

Nucleic acids encoding HpaG polypeptides may be derived from any natural or artificial source. The nucleic acid may be modified from its native form in composition and/or genomic environment through deliberate human manipulation. Preferably the HpaG polypeptide-encoding nucleic acid is of prokaryotic origin, preferably from a Gram-negative bacterium possessing a TTSS, further preferably from a plant pathogenic bacterium possessing a TTSS, more preferably from the family of Pseudomonaceae, furthermore preferably from the genus *Xanthomonas*, most preferably the nucleic acid is from *Xanthomonas axonopodis*.

Performance of the methods of the invention gives plants having enhanced yield-related traits. In particular performance of the methods of the invention gives plants having increased yield, especially increased biomass and/or increased seed yield relative to control plants. The terms "yield" and "seed yield" are described in more detail in the "definitions" section herein.

Reference herein to enhanced yield-related traits is taken to mean an increase in biomass (weight) of one or more parts of a plant, which may include aboveground (harvestable) parts and/or (harvestable) parts below ground. In particular, such harvestable parts are seeds, and performance of the methods of the invention results in plants having increased seed yield relative to the seed yield of suitable control plants.

Taking corn as an example, a yield increase may be manifested as one or more of the following: increase in the number of plants established per hectare or acre, an increase in the number of ears per plant, an increase in the number of rows, number of kernels per row, kernel weight, thousand kernel weight, ear length/diameter, increase in the seed filling rate (which is the number of filled seeds divided by the total number of seeds and multiplied by 100), among others. Taking rice as an example, a yield increase may manifest itself as an increase in one or more of the following: number of plants per hectare or acre, number of panicles per plant, number of spikelets per panicle, number of flowers (florets) per panicle (which is expressed as a ratio of the number of filled seeds over the number of primary panicles), increase in the seed filling rate (which is the number of filled seeds divided by the total number of seeds and multiplied by 100), increase in thousand kernel weight, among others.

The present invention provides a method for increasing yield, especially biomass and/or seed yield of plants, relative to control plants, which method comprises modulating expression, preferably increasing expression, in a plant of a nucleic acid encoding an HpaG polypeptide as defined herein. It should be noted that the observed yield increase is not the result of increased biotic stress resistance.

Since the transgenic plants according to the present invention have increased yield, it is likely that these plants exhibit an increased growth rate (during at least part of their life cycle), relative to the growth rate of control plants at a corresponding stage in their life cycle. Besides the increased yield capacity, an increased efficiency of nutrient uptake may also contribute to the increase in yield. It is observed that the plants according to the present invention show a higher efficiency in nutrient uptake. Increased efficiency of nutrient uptake allows better growth of the plant.

The increased growth rate may be specific to one or more parts of a plant (including seeds), or may be throughout substantially the whole plant. Plants having an increased growth rate may have a shorter life cycle. The life cycle of a plant may be taken to mean the time needed to grow from a mature seed up to the stage where the plant has produced mature seeds, similar to the starting material. This life cycle may be influenced by factors such as early vigour, growth rate, greenness index, flowering time and speed of seed maturation. The increase in growth rate may take place at one or more stages in the life cycle of a plant or during substantially the whole plant life cycle. Increased growth rate during the early stages in the life cycle of a plant may reflect enhanced vigour. The increase in growth rate may alter the harvest cycle of a plant allowing plants to be sown later and/or harvested sooner than would otherwise be possible (a similar effect may be obtained with earlier flowering time). If the

growth rate is sufficiently increased, it may allow for the further sowing of seeds of the same plant species (for example sowing and harvesting of rice plants followed by sowing and harvesting of further rice plants all within one conventional growing period). Similarly, if the growth rate is sufficiently increased, it may allow for the further sowing of seeds of different plants species (for example the sowing and harvesting of corn plants followed by, for example, the sowing and optional harvesting of soybean, potato or any other suitable plant). Harvesting additional times from the same rootstock in the case of some crop plants may also be possible. Altering the harvest cycle of a plant may lead to an increase in annual biomass production per acre (due to an increase in the number of times (say in a year) that any particular plant may be grown and harvested). An increase in growth rate may also allow for the cultivation of transgenic plants in a wider geographical area than their wild-type counterparts, since the territorial limitations for growing a crop are often determined by adverse environmental conditions either at the time of planting (early season) or at the time of harvesting (late season). Such adverse conditions may be avoided if the harvest cycle is shortened. The growth rate may be determined by deriving various parameters from growth curves, such parameters may be: T-Mid (the time taken for plants to reach 50% of their maximal size) and T-90 (time taken for plants to reach 90% of their maximal size), amongst others.

According to a preferred feature of the present invention, performance of the methods of the invention gives plants having an increased growth rate relative to control plants. Therefore, according to the present invention, there is provided a method for increasing the growth rate of plants, which method comprises modulating expression, preferably increasing expression, in a plant of a nucleic acid encoding an HpaG polypeptide as defined herein. It should be noted that the observed increase in growth rate is not the result of biotic stress resistance.

An increase in yield and/or growth rate occurs whether the plant is under non-stress conditions or whether the plant is exposed to various abiotic stresses compared to control plants. Plants typically respond to exposure to abiotic stress by growing more slowly. In conditions of severe stress, the plant may even stop growing altogether. Mild stress on the other hand is defined herein as being any stress to which a plant is exposed which does not result in the plant ceasing to grow altogether without the capacity to resume growth. Mild stress in the sense of the invention leads to a reduction in the growth of the stressed plants of less than 40%, 35% or 30%, preferably less than 25%, 20% or 15%, more preferably less than 14%, 13%, 12%, 11% or 10% or less in comparison to the control plant under non-stress conditions. Due to advances in agricultural practices (irrigation, fertilization, pesticide treatments) severe stresses are not often encountered in cultivated crop plants. As a consequence, the compromised growth induced by mild stress is often an undesirable feature for agriculture. The term “mild

stresses" are the everyday abiotic (environmental) stresses to which a plant is exposed. Abiotic stresses may be due to drought or excess water, anaerobic stress, salt stress, chemical toxicity, oxidative stress and hot, cold or freezing temperatures. The abiotic stress may be an osmotic stress caused by a water stress (particularly due to drought), salt stress, oxidative stress or an ionic stress.

The term "abiotic stress" as defined herein is taken to mean any one or more of: water stress (due to drought or excess water), anaerobic stress, salt stress, temperature stress (due to hot, cold or freezing temperatures), chemical toxicity stress and oxidative stress. According to one aspect of the invention, the abiotic stress is an osmotic stress, selected from water stress, salt stress, oxidative stress and ionic stress. Preferably, the water stress is drought stress. The term salt stress is not restricted to common salt (NaCl), but may be any one or more of: NaCl, KCl, LiCl, $MgCl_2$, $CaCl_2$, amongst others.

Another example of abiotic environmental stress is the reduced availability of one or more nutrients that need to be assimilated by the plants for growth and development. Because of the strong influence of nutrition utilization efficiency on plant yield and product quality, a huge amount of fertilizer is poured onto fields to optimize plant growth and quality. Productivity of plants ordinarily is limited by three primary nutrients, phosphorous, potassium and nitrogen, which is usually the rate-limiting element in plant growth of these three. Therefore the major nutritional element required for plant growth is nitrogen (N). It is a constituent of numerous important compounds found in living cells, including amino acids, proteins (enzymes), nucleic acids, and chlorophyll. 1.5% to 2% of plant dry matter is nitrogen and approximately 16% of total plant protein. Thus, nitrogen availability is a major limiting factor for crop plant growth and production (Frink et al. (1999) Proc Natl Acad Sci USA 96(4): 1175-1180), and has as well a major impact on protein accumulation and amino acid composition. Therefore, of great interest are crop plants with an increased yield when grown under nitrogen-limiting conditions.

Biotic stresses are typically those stresses caused by pathogens, such as bacteria, viruses, fungi, nematodes and insects.

In particular, the methods of the present invention may be performed under non-stress conditions or under conditions of drought to give plants having increased yield relative to control plants. As reported in Wang et al. (Planta (2003) 218: 1-14), abiotic stress leads to a series of morphological, physiological, biochemical and molecular changes that adversely affect plant growth and productivity. Drought, salinity, extreme temperatures and oxidative stress are known to be interconnected and may induce growth and cellular damage through

similar mechanisms. Rabbani et al. (Plant Physiol (2003) 133: 1755-1767) describes a particularly high degree of "cross talk" between drought stress and high-salinity stress. For example, drought and/or salinisation are manifested primarily as osmotic stress, resulting in the disruption of homeostasis and ion distribution in the cell. Oxidative stress, which frequently accompanies high or low temperature, salinity or drought stress, may cause denaturing of functional and structural proteins. As a consequence, these diverse environmental stresses often activate similar cell signalling pathways and cellular responses, such as the production of stress proteins, up-regulation of anti-oxidants, accumulation of compatible solutes and growth arrest.

The term "non-stress" conditions as used herein are those environmental conditions that allow optimal growth of plants. Persons skilled in the art are aware of normal soil conditions and climatic conditions for any given location.

Performance of the methods of the invention gives plants, grown under non-stress conditions or under drought stress conditions, increased yield relative to suitable control plants grown under comparable conditions. Therefore, according to the present invention, there is provided a method for increasing yield in plants grown under non-stress conditions or under drought conditions, which method comprises increasing expression in a plant of a nucleic acid encoding an HpaG polypeptide.

Furthermore, performance of the methods of the invention gives plants grown under conditions of nutrient deficiency, particularly under conditions of nitrogen deficiency, increased yield relative to control plants grown under comparable conditions. Therefore, according to the present invention, there is also provided a method for increasing yield in plants grown under conditions of nutrient deficiency, which method comprises increasing expression in a plant of a nucleic acid encoding an HpaG polypeptide.

Performance of the methods of the invention also gives plants having increased plant vigour relative to control plants, particularly during the early stages of plant development (typically three, four weeks post germination in the case of rice and maize, but this will vary from species to species) leading to early vigour. Therefore, according to the present invention, there is provided a method for increasing the plant early vigour, which method comprises modulating, preferably increasing, expression in a plant of a nucleic acid encoding a HpaG polypeptide. Preferably the increase in seedling vigour is achieved by expressing the nucleic acid encoding the HpaG polypeptide under the control of a shoot specific promoter. There is also provided a method for producing plants having early vigour relative to control plants, which method

comprises modulating, preferably increasing, expression in a plant of a nucleic acid encoding a HpaG polypeptide.

Early vigour may also result from increased plant fitness due to, for example, the plants being better adapted to their environment (i.e. optimizing the use of energy resources and partitioning between shoot and root). Plants having early vigour also show increase seedling survival and a better establishment of the crop, which often results in highly uniform fields (with the crop growing in uniform manner, i.e. with the majority of plants reaching the various stages of development at substantially the same time), and often better and higher yield. Therefore, early vigour may be determined by measuring various factors, such as thousand kernel weight, percentage germination, percentage emergence, seedling growth, seedling height, root length, root and shoot biomass and many more.

The present invention encompasses plants or parts thereof (including seeds) obtainable by the methods according to the present invention. The plants or parts thereof comprise a nucleic acid transgene encoding an HpaG polypeptide as defined above.

The invention also provides genetic constructs and vectors to facilitate introduction and/or expression in plants of nucleic acids encoding HpaG polypeptides. The gene constructs may be inserted into vectors, which may be commercially available, suitable for transforming into plants and suitable for expression of the gene of interest in the transformed cells. The invention also provides use of a gene construct as defined herein in the methods of the invention.

More specifically, the present invention provides a construct comprising:

(a) a nucleic acid encoding an HpaG polypeptide as defined above;

(b) one or more control sequences capable of driving expression of the nucleic acid sequence of (a); and optionally

(c) a transcription termination sequence.

Preferably, the HpaG encoding nucleic acid is

(i) a nucleic acid as presented by SEQ ID NO: 1 or the complement thereof,

(ii) a nucleic acid encoding an HpaG polypeptide as defined above.

The term “control sequence” and “termination sequence” are as defined herein.

Plants are transformed with a vector comprising any of the nucleic acids described above. The skilled artisan is well aware of the genetic elements that must be present on the vector in order to successfully transform, select and propagate host cells containing the sequence of interest. The sequence of interest is operably linked to one or more control sequences (at least to a promoter).

Advantageously, any type of promoter, whether natural or synthetic, may be used to drive expression of the nucleic acid sequence. A constitutive promoter or a green tissue specific promoter is particularly useful in the methods. See the "Definitions" section herein for definitions of the various promoter types.

Preferably, the *HpaG* nucleic acid or variant thereof is operably linked to a constitutive promoter. A preferred constitutive promoter is one that is also substantially ubiquitously expressed. Further preferably the promoter is derived from a plant, more preferably a monocotyledonous plant. Most preferred is use of a GOS2 promoter (from rice) (SEQ ID NO: 5). It should be clear that the applicability of the present invention is not restricted to the *HpaG* nucleic acid represented by SEQ ID NO: 1, nor is the applicability of the invention restricted to expression of a *HpaG* nucleic acid when driven by a GOS2 promoter. Examples of other constitutive promoters which may also be used to drive expression of an *HpaG* nucleic acid are shown in Table 2a in the Definitions section herein.

Preferably, the consecutive promoter is of medium strength and has weaker activity than the CaMV 35S promoter.

Alternatively, the *HpaG* nucleic acid or variant thereof is operably linked to a green tissue-specific promoter. A green tissue-specific promoter as defined herein is a promoter that is transcriptionally active predominantly in green tissue, substantially to the exclusion of any other parts of a plant, whilst still allowing for any leaky expression in these other plant parts. The green tissue-specific promoter is preferably a protochlorophylid reductase promoter, more preferably the protochlorophylid reductase promoter represented by a nucleic acid sequence substantially similar to SEQ ID NO: 6, most preferably the promoter is as represented by SEQ ID NO: 6. It should be clear that the applicability of the present invention is not restricted to the HpaG encoding nucleic acid represented by SEQ ID NO: 1, nor is the applicability of the invention restricted to expression of such a HpaG encoding nucleic acid when driven by a protochlorophylid reductase promoter. Examples of other green tissue-specific promoters which may also be used to perform the methods of the invention are shown in the definitions section herein.

For the identification of functionally equivalent promoters, the promoter strength and/or expression pattern of a candidate promoter may be analysed for example by operably linking the promoter to a reporter gene and assaying the expression level and pattern of the reporter gene in various tissues of the plant. Suitable well-known reporter genes include for example beta-glucuronidase or beta galactosidase. The promoter activity is assayed by measuring the enzymatic activity of the beta-glucuronidase or beta-galactosidase. The promoter strength and/or expression pattern may then be compared to that of a reference promoter (such as the one used in the methods of the present invention). Alternatively, promoter strength may be assayed by quantifying mRNA levels or by comparing mRNA levels of the nucleic acid used in the methods of the present invention, with mRNA levels of housekeeping genes such as 18S rRNA, using methods known in the art, such as Northern blotting with densitometric analysis of autoradiograms, quantitative real-time PCR or RT-PCR (Heid et al., 1996 Genome Methods 6: 986-994). Generally a "weak promoter" refers to a promoter that drives expression of a coding sequence at a low level. By "low level" is intended at levels of about 1/10,000 transcripts to about 1/100,000 transcripts, to about 1/500,0000 transcripts per cell. Conversely, a "strong promoter" drives expression of a coding sequence at high level, or at about 1/10 transcripts to about 1/100 transcripts to about 1/1,000 transcripts per cell.

Optionally, one or more terminator sequences may be used in the construct introduced into a plant. Additional regulatory elements may include transcriptional as well as translational enhancers. Those skilled in the art will be aware of terminator and enhancer sequences that may be suitable for use in performing the invention. Such sequences would be known or may readily be obtained by a person skilled in the art.

An intron sequence may also be added to the 5' untranslated region (UTR) or in the coding sequence to increase the amount of the mature message that accumulates in the cytosol. Inclusion of a spliceable intron in the transcription unit in both plant and animal expression constructs has been shown to increase gene expression at both the mRNA and protein levels up to 1000-fold (Buchman and Berg, Mol. Cell Biol. 8:4395-4405 (1988); Callis et al., Genes Dev. 1:1183-1200 (1987)). Such intron enhancement of gene expression is typically greatest when placed near the 5' end of the transcription unit. Use of the maize introns Adh1-S intron 1, 2, and 6, the Bronze-1 intron are known in the art. For general information, see The Maize Handbook, Chapter 116, Freeling and Walbot, Eds., Springer, N.Y. (1994).

Other control sequences (besides promoter, enhancer, silencer, intron sequences, 3'UTR and/or 5'UTR regions) may be protein and/or RNA stabilizing elements. Such sequences

would be known or may readily be obtained by a person skilled in the art. Furthermore, the codon usage of the coding sequence to be inserted on the construct may be optimised with reference to the host cell into which the construct will be introduced. While the genetic code is degenerated, organisms tend to use a particular codon for an amino acid more than other codons for that same amino acid. Tables with preferred codon usage for various organisms are known in the art.

The genetic constructs of the invention may further include an origin of replication sequence that is required for maintenance and/or replication in a specific cell type. One example is when a genetic construct is required to be maintained in a bacterial cell as an episomal genetic element (e.g. plasmid or cosmid molecule). Preferred origins of replication include, but are not limited to, the f1-ori and colE1.

For the detection of the successful transfer of the nucleic acid sequences as used in the methods of the invention and/or selection of transgenic plants comprising these nucleic acids, it is advantageous to use marker genes (or reporter genes). Therefore, the genetic construct may optionally comprise a selectable marker gene. Selectable markers are described in more detail in the "definitions" section herein.

It is known that upon stable or transient integration of nucleic acids into plant cells, only a minority of the cells takes up the foreign DNA and, if desired, integrates it into its genome, depending on the expression vector used and the transfection technique used. To identify and select these integrants, a gene coding for a selectable marker (such as the ones described above) is usually introduced into the host cells together with the gene of interest. These markers can for example be used in mutants in which these genes are not functional by, for example, deletion by conventional methods. Furthermore, nucleic acid molecules encoding a selectable marker can be introduced into a host cell on the same vector that comprises the sequence encoding the polypeptides of the invention or used in the methods of the invention, or else in a separate vector. Cells which have been stably transfected with the introduced nucleic acid can be identified for example by selection (for example, cells which have integrated the selectable marker survive whereas the other cells die).

Since the marker genes, particularly genes for resistance to antibiotics and herbicides, are no longer required or are undesired in the transgenic host cell once the nucleic acids have been introduced successfully, the process according to the invention for introducing the nucleic acids advantageously employs techniques which enable the removal or excision of these marker genes. One such a method is what is known as co-transformation. The co-

transformation method employs two vectors simultaneously for the transformation, one vector bearing the nucleic acid according to the invention and a second bearing the marker gene(s). A large proportion of transformants receives or, in the case of plants, comprises (up to 40% or more of the transformants), both vectors. In case of transformation with Agrobacteria, the transformants usually receive only a part of the vector, i.e. the sequence flanked by the T-DNA, which usually represents the expression cassette. The marker genes can subsequently be removed from the transformed plant by performing crosses. In another method, marker genes integrated into a transposon are used for the transformation together with desired nucleic acid (known as the Ac/Ds technology). The transformants can be crossed with a transposase source or the transformants are transformed with a nucleic acid construct conferring expression of a transposase, transiently or stable. In some cases (approx. 10%), the transposon jumps out of the genome of the host cell once transformation has taken place successfully and is lost. In a further number of cases, the transposon jumps to a different location. In these cases the marker gene must be eliminated by performing crosses. In microbiology, techniques were developed which make possible, or facilitate, the detection of such events. A further advantageous method relies on what is known as recombination systems; whose advantage is that elimination by crossing can be dispensed with. The best-known system of this type is what is known as the Cre/lox system. Cre1 is a recombinase that removes the sequences located between the loxP sequences. If the marker gene is integrated between the loxP sequences, it is removed once transformation has taken place successfully, by expression of the recombinase. Further recombination systems are the HIN/HIX, FLP/FRT and REP/STB system (Tribble et al., J. Biol. Chem., 275, 2000: 22255-22267; Velmurugan et al., J. Cell Biol., 149, 2000: 553-566). A site-specific integration into the plant genome of the nucleic acid sequences according to the invention is possible. Naturally, these methods can also be applied to microorganisms such as yeast, fungi or bacteria.

The invention also provides a method for the production of transgenic plants having enhanced yield-related traits relative to control plants, comprising introduction and expression in a plant of any nucleic acid encoding an HpaG polypeptide as defined hereinabove.

More specifically, the present invention provides a method for the production of transgenic plants having increased enhanced yield-related traits, particularly increased biomass and/or seed yield, which method comprises:

(i) introducing and expressing in a plant or plant cell an HpaG polypeptide-encoding nucleic acid; and

(ii) cultivating the plant cell under conditions promoting plant growth and development.

The nucleic acid of (i) may be any of the nucleic acids capable of encoding an HpaG polypeptide as defined herein.

The nucleic acid may be introduced directly into a plant cell or into the plant itself (including introduction into a tissue, organ or any other part of a plant). According to a preferred feature of the present invention, the nucleic acid is preferably introduced into a plant by transformation. The term "transformation" is described in more detail in the "definitions" section herein.

The genetically modified plant cells can be regenerated via all methods with which the skilled worker is familiar. Suitable methods can be found in the abovementioned publications by S.D. Kung and R. Wu, Potrykus or Höfgen and Willmitzer.

Generally after transformation, plant cells or cell groupings are selected for the presence of one or more markers which are encoded by plant-expressible genes co-transferred with the gene of interest, following which the transformed material is regenerated into a whole plant. To select transformed plants, the plant material obtained in the transformation is, as a rule, subjected to selective conditions so that transformed plants can be distinguished from untransformed plants. For example, the seeds obtained in the above-described manner can be planted and, after an initial growing period, subjected to a suitable selection by spraying. A further possibility consists in growing the seeds, if appropriate after sterilization, on agar plates using a suitable selection agent so that only the transformed seeds can grow into plants. Alternatively, the transformed plants are screened for the presence of a selectable marker such as the ones described above.

Following DNA transfer and regeneration, putatively transformed plants may also be evaluated, for instance using Southern analysis, for the presence of the gene of interest, copy number and/or genomic organisation. Alternatively or additionally, expression levels of the newly introduced DNA may be monitored using Northern and/or Western analysis, both techniques being well known to persons having ordinary skill in the art.

The generated transformed plants may be propagated by a variety of means, such as by clonal propagation or classical breeding techniques. For example, a first generation (or T1) transformed plant may be selfed and homozygous second-generation (or T2) transformants selected, and the T2 plants may then further be propagated through classical breeding techniques.

The generated transformed organisms may take a variety of forms. For example, they may be chimeras of transformed cells and non-transformed cells; clonal transformants (e.g., all cells transformed to contain the expression cassette); grafts of transformed and untransformed tissues (e.g., in plants, a transformed rootstock grafted to an untransformed scion).

The present invention clearly extends to any plant cell or plant produced by any of the methods described herein, and to all plant parts and propagules thereof. The present invention extends further to encompass the progeny of a primary transformed or transfected cell, tissue, organ or whole plant that has been produced by any of the aforementioned methods, the only requirement being that progeny exhibit the same genotypic and/or phenotypic characteristic(s) as those produced by the parent in the methods according to the invention.

The invention also includes host cells containing an isolated nucleic acid encoding an HpaG polypeptide as defined hereinabove. Preferred host cells according to the invention are plant cells. Host plants for the nucleic acids or the vector used in the method according to the invention, the expression cassette or construct or vector are, in principle, advantageously all plants, which are capable of synthesizing the polypeptides used in the inventive method.

The methods of the invention are advantageously applicable to any plant.

Plants that are particularly useful in the methods of the invention include all plants which belong to the superfamily Viridiplantae, in particular monocotyledonous and dicotyledonous plants including fodder or forage legumes, ornamental plants, food crops, trees or shrubs. According to a preferred embodiment of the present invention, the plant is a crop plant. Examples of crop plants include soybean, sunflower, canola, alfalfa, rapeseed, cotton, tomato, potato and tobacco. Further preferably, the plant is a monocotyledonous plant. Examples of monocotyledonous plants include sugarcane. More preferably the plant is a cereal. Examples of cereals include rice, maize, wheat, barley, millet, triticale, rye, sorghum and oats.

The invention also extends to harvestable parts of a plant such as, but not limited to seeds, leaves, fruits, flowers, stems, rhizomes, tubers and bulbs. The invention furthermore relates to products derived, preferably directly derived, from a harvestable part of such a plant, such as dry pellets or powders, oil, fat and fatty acids, starch or proteins.

According to a preferred feature of the invention, the modulated expression is increased expression. Methods for increasing expression of nucleic acids or genes, or gene products, are well documented in the art and include, for example, overexpression driven by appropriate

promoters, the use of transcription enhancers or translation enhancers. Isolated nucleic acids which serve as promoter or enhancer elements may be introduced in an appropriate position (typically upstream) of a non-heterologous form of a polynucleotide so as to upregulate expression. For example, endogenous promoters may be altered in vivo by mutation, deletion, and/or substitution (see, Kmiec, U.S. Pat. No. 5,565,350; Zarling et al., PCT/US93/03868), or isolated promoters may be introduced into a plant cell in the proper orientation and distance from a gene of the present invention so as to control the expression of the gene.

If polypeptide expression is desired, it is generally desirable to include a polyadenylation region at the 3'-end of a polynucleotide coding region. The polyadenylation region can be derived from the natural gene, from a variety of other plant genes, or from T-DNA. The 3' end sequence to be added may be derived from, for example, the nopaline synthase or octopine synthase genes, or alternatively from another plant gene, or less preferably from any other eukaryotic gene.

The present invention also encompasses use of nucleic acids encoding HpaG polypeptides as described herein and use of these HpaG polypeptide in enhancing any of the aforementioned yield-related traits in plants.

The methods according to the present invention result in plants having enhanced yield-related traits, as described hereinbefore. These traits may also be combined with other economically advantageous traits, such as further yield-enhancing traits, tolerance to other abiotic and biotic stresses, traits modifying various architectural features and/or biochemical and/or physiological features.

II. SNF2

According to a first embodiment, the present invention provides a method for enhancing yield-related traits in plants relative to control plants, comprising increasing expression in a plant of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide.

A preferred method for increasing expression of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide is by introducing and expressing in a plant a nucleic acid sequence encoding a SWI2/SNF2 polypeptide.

Any reference hereinafter to a “protein useful in the methods of the invention” is taken to mean an SWI2/SNF2 polypeptide as defined herein. Any reference hereinafter to a “nucleic acid sequence useful in the methods of the invention” is taken to mean a nucleic acid sequence

capable of encoding such an SWI2/SNF2 polypeptide. The nucleic acid sequence to be introduced into a plant (and therefore useful in performing the methods of the invention) is any nucleic acid sequence encoding the type of protein, which will now be described, hereafter also named "SWI2/SNF2 nucleic acid sequence" or "SWI2/SNF2 gene".

An "SWI2/SNF2 polypeptide" as defined herein refers to any polypeptide which comprises an ATPase domain comprising from N-terminus to C-terminus at least five, preferably six, more preferably seven, most preferably eight of the following motifs:

(i) Motif I LADDMGLGK(T/S), as represented by SEQ ID N0: 103 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif I;

(ii) Motif Ia L(L/V/I)(V/I/L)(A/C)P(T/M/V)S(V/I/L)(V/I/L)XNW, as represented by SEQ ID N0: 104 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif Ia;

(iii) Motif II DEAQ(N/A/H)(V/I/L)KN, as represented by SEQ ID N0: 105 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif II;

(iv) Motif III A(L/M)TGTPXEN, as represented by SEQ ID N0: 106 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif III;

(v) Motif IV (L/I)XF(T/S)Q(F/Y), as represented by SEQ ID N0: 107 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif IV;

(vi) Motif V S(L/V)KAGG(V/T/L)G(L/I)(N/T)LTXA(N/S/T)HV, as represented by SEQ ID N0: 108 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif V;

(vii) Motif Va DRWWNPAVE, as represented by SEQ ID N0: 109 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif Va; and

(viii) Motif VI QA(T/S)DR(A/T/V)(F/Y)R(I/L)GQ, as represented by SEQ ID N0: 110 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif VI,

where X in Motif Ia, Motif III, Motif IV, and Motif V, is any amino acid.

Alternatively or additionally, an "SWI2/SNF2 polypeptide" as defined herein refers to any polypeptide sequence which when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7 (described in Flaus *et al.* (2006), *supra*), tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30, rather than with any other SWI2/SNF2 clade.

Alternatively or additionally, an "SWI2/SNF2 polypeptide" as defined herein refers to any polypeptide sequence comprising an ATPase domain having in increasing order of preference at least 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the ATPase domain as represented by SEQ ID NO: 111, comprised in SEQ ID NO: 30.

Alternatively or additionally, an "SWI2/SNF2 polypeptide" as defined herein refers to any polypeptide having in increasing order of preference at least 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the SWI2/SNF2 polypeptide as represented by SEQ ID NO: 30 or to any of the polypeptide sequences given in Table E herein.

The terms "domain" and "motif" are defined in the "definitions" section herein. Specialist databases exist for the identification of domains, for example, SMART (Schultz et al. (1998) Proc. Natl. Acad. Sci. USA 95, 5857-5864; Letunic et al. (2002) Nucleic Acids Res 30, 242-244), InterPro (Mulder et al., (2003) Nucl. Acids. Res. 31, 315-318, Prosite (Bucher and Bairoch (1994), A generalized profile syntax for biomolecular sequences motifs and its function in automatic sequence interpretation. (In) ISMB-94; Proceedings 2nd International Conference on Intelligent Systems for Molecular Biology. Altman R., Brutlag D., Karp P., Lathrop R., Searls D., Eds., pp53-61, AAAI Press, Menlo Park; Hulo et al., (2004) Nucl. Acids. Res. 32: D134-D137), or Pfam (Bateman *et al.,* (2002) Nucleic Acids Research 30(1): 276-280). A set of tools for in silico analysis of protein sequences is available on the ExPASY proteomics server (hosted by the Swiss Institute of Bioinformatics (Gasteiger et al., (2003) ExPASy: the proteomics server for in-depth protein knowledge and analysis, Nucleic Acids Res 31: 3784-3788). Domains may also be identified using routine techniques, such as by sequence alignment. Analysis of the polypeptide sequence of SEQ ID NO: 30 is presented below in Examples 9 and 11.

Methods for the alignment of sequences for comparison are well known in the art, such methods include GAP, BESTFIT, BLAST, FASTA and TFASTA. GAP uses the algorithm of Needleman and Wunsch ((1970) J Mol Biol 48: 443-453) to find the global (i.e. spanning the complete sequences) alignment of two sequences that maximizes the number of matches and minimizes the number of gaps. The BLAST algorithm (Altschul et al. (1990) J Mol Biol 215: 403-10) calculates percent sequence identity and performs a statistical analysis of the similarity between the two sequences. The software for performing BLAST analysis is publicly available through the National Centre for Biotechnology Information (NCBI). Homologues may readily be identified using, for example, the ClustalW multiple sequence alignment algorithm (version 1.83), with the default pairwise alignment parameters, and a scoring method in percentage. Global percentages of similarity and identity may also be determined using one of the methods available in the MatGAT software package (Campanella et al., BMC Bioinformatics. 2003 Jul 10;4:29. MatGAT: an application that generates similarity/identity matrices using protein or DNA sequences.). Minor manual editing may be performed to optimise alignment between conserved motifs, as would be apparent to a person skilled in the art. Furthermore, instead of using full-length sequences for the identification of homologues, specific domains may also be used. The sequence identity values, which are indicated below in Example 3 as a percentage were determined over the entire nucleic acid or polypeptide sequence (Table F herein), and/or over selected domains (such as the ATPase domain as represented by SEQ ID NO: 111, comprised in SEQ ID NO: 30; Table F1 herein) or conserved motif(s), using the programs mentioned above using the default parameters.

The present invention is illustrated by transforming plants with the nucleic acid sequence represented by SEQ ID NO: 29, encoding the polypeptide sequence of SEQ ID NO: 30. However, performance of the invention is not restricted to these sequences; the methods of the invention may advantageously be performed using any SWI2/SNF2-encoding nucleic acid sequence or SWI2/SNF2 polypeptides as defined herein.

Examples of nucleic acid sequences encoding plant SWI2/SNF2 polypeptides are given in Table E of Example 8 herein. Such nucleic acid sequences are useful in performing the methods of the invention. The polypeptide sequences given in Table E of Example 8 are example sequences of orthologues and paralogues of the SWI2/SNF2 polypeptides represented by SEQ ID NO: 30, the terms “orthologues” and “paralogues” being as defined herein. Further orthologues and paralogues may readily be identified by performing a so-called reciprocal blast search. Typically, this involves a first BLAST involving BLASTing a query sequence (for example using any of the sequences listed in Table E of Example 8) against any sequence database, such as the publicly available NCBI database. BLASTN or

TBLASTX (using standard default values) are generally used when starting from a nucleotide sequence, and BLASTP or TBLASTN (using standard default values) when starting from a protein sequence. The BLAST results may optionally be filtered. The full-length sequences of either the filtered results or non-filtered results are then BLASTed back (second BLAST) against sequences from the organism from which the query sequence is derived (where the query sequence is SEQ ID NO: 29 or SEQ ID NO: 30, the second BLAST would therefore be against *Synechocystis* sequences). The results of the first and second BLASTs are then compared. A paralogue is identified if a high-ranking hit from the first blast is from the same species as from which the query sequence is derived, a BLAST back then ideally results in the query sequence amongst the highest hits; an orthologue is identified if a high-ranking hit in the first BLAST is not from the same species as from which the query sequence is derived, and preferably results upon BLAST back in the query sequence being among the highest hits.

High-ranking hits are those having a low E-value. The lower the E-value, the more significant the score (or in other words the lower the chance that the hit was found by chance). Computation of the E-value is well known in the art. In addition to E-values, comparisons are also scored by percentage identity. Percentage identity refers to the number of identical nucleotides (or amino acids) between the two compared nucleic acid (or polypeptide) sequences over a particular length. In the case of large families, ClustalW may be used, followed by a neighbour joining tree, to help visualize clustering of related genes and to identify orthologues and paralogues (see Figure 7).

Nucleic acid variants may also be useful in practising the methods of the invention. Examples of such variants include nucleic acid sequences encoding homologues and derivatives of any one of the polypeptide sequences given in Table E of Example 8, the terms “homologue” and “derivative” being as defined herein. Also useful in the methods of the invention are nucleic acid sequences encoding homologues and derivatives of orthologues or paralogues of any one of the polypeptide sequences given in Table E of Example 8. Homologues and derivatives useful in the methods of the present invention have substantially the same biological and functional activity as the unmodified protein from which they are derived.

Further nucleic acid variants useful in practising the methods of the invention include portions of nucleic acid sequences encoding SWI2/SNF2 polypeptides, nucleic acid sequences hybridising to nucleic acid sequences encoding SWI2/SNF2 polypeptides, splice variants of nucleic acid sequences encoding SWI2/SNF2 polypeptides, allelic variants of nucleic acid sequences encoding SWI2/SNF2 polypeptides, and variants of nucleic acid sequences

encoding SWI2/SNF2 polypeptides obtained by gene shuffling. The terms hybridising sequence, splice variant, allelic variant and gene shuffling are as described herein.

Nucleic acid sequences encoding SWI2/SNF2 polypeptides need not be full-length nucleic acid sequences, since performance of the methods of the invention does not rely on the use of full-length nucleic acid sequences. According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant a portion of any one of the nucleic acid sequences given in Table E of Example 8, or a portion of a nucleic acid sequence encoding an orthologue, paralogue or homologue of any of the polypeptide sequences given in Table E of Example 8.

A portion of a nucleic acid sequence may be prepared, for example, by making one or more deletions to the nucleic acid sequence. The portions may be used in isolated form or they may be fused to other coding (or non-coding) sequences in order to, for example, produce a protein that combines several activities. When fused to other coding sequences, the resultant polypeptide produced upon translation may be bigger than that predicted for the protein portion.

Portions useful in the methods of the invention, encode SWI2/SNF2 polypeptides as defined herein, and have substantially the same biological activity (i.e., enhancing yield-related traits) as the polypeptide sequences given in Table E of Example 8. Preferably, the portion is a portion of any one of the nucleic acid sequences given in Table E of Example 8, or is a portion of a nucleic acid sequence encoding an orthologue or paralogue of any one of the polypeptide sequences given in Table E of Example 8. Preferably the portion is, in increasing order of preference at least 1000, 1100, 1200, 1300 or 1400 consecutive nucleotides in length, the consecutive nucleotides being of any one of the nucleic acid sequences given in Table E of Example 8, or of a nucleic acid sequence encoding an orthologue or paralogue of any one of the polypeptide sequences given in Table E of Example 8. Most preferably the portion is a portion of the nucleic acid sequence of SEQ ID NO: 29. Preferably, the portion encodes a polypeptide sequence comprising any one or more of the domains or motifs defined herein. Preferably, the portion encodes a polypeptide sequence which when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7, tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30 rather than with any other SWI2/SNF2 clade.

Another nucleic acid variant useful in the methods of the invention is a nucleic acid sequence capable of hybridising, under reduced stringency conditions, preferably under stringent

conditions, with a nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined herein, or with a portion as defined herein.

According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant a nucleic acid sequence capable of hybridizing to any one of the nucleic acid sequences given in Table E of Example 8, or comprising introducing and expressing in a plant a nucleic acid sequence capable of hybridising to a nucleic acid sequence encoding an orthologue, paralogue or homologue of any of the nucleic acid sequences given in Table E of Example 8.

Hybridising sequences useful in the methods of the invention encode a SWI2/SNF2 polypeptide as defined herein, and have substantially the same biological activity (i.e., enhancing yield-related traits) as the polypeptide sequences given in Table E of Example 8. Preferably, the hybridising sequence is capable of hybridising to any one of the nucleic acid sequences given in Table E of Example 8, or to a portion of any of these sequences, a portion being as defined above, or wherein the hybridising sequence is capable of hybridising to a nucleic acid sequence encoding an orthologue or paralogue of any one of the polypeptide sequences given in Table E of Example 8. Most preferably, the hybridising sequence is capable of hybridising to a nucleic acid sequence as represented by SEQ ID NO: 29 or to a portion thereof. Preferably, the hybridising sequence encodes a polypeptide sequence comprising any one or more of the motifs or domains as defined herein. Preferably, the hybridising sequence encodes a polypeptide sequence which when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7, tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30 rather than with any other SWI2/SNF2 clade.

Another nucleic acid variant useful in the methods of the invention is a splice variant encoding a SWI2/SNF2 polypeptide as defined hereinabove, a splice variant being as defined herein.

According to the present invention, there is provided a method for enhancing yield related traits in plants, comprising introducing and expressing in a plant a splice variant of any one of the nucleic acid sequences given in Table E of Example 8, or a splice variant of a nucleic acid sequence encoding an orthologue, paralogue or homologue of any of the polypeptide sequences given in Table E of Example 8.

The splice variants useful in the methods of the present invention have substantially the same biological activity (i.e., enhancing yield-related traits) as the SWI2/SNF2 polypeptide of SEQ ID

NO: 30 and any of the polypeptide sequences depicted in Table E of Example 8. Preferably, the polypeptide sequence encoded by the splice variant comprises any one or more of the motifs or domains as defined herein. Preferably, the polypeptide sequence encoded by the splice variant, when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7, tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30 rather than with any other SWI2/SNF2 clade.

Another nucleic acid variant useful in performing the methods of the invention is an allelic variant of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined hereinabove, an allelic variant being as defined herein.

According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant an allelic variant of any one of the nucleic acid sequences given in Table E of Example 8, or comprising introducing and expressing in a plant an allelic variant of a nucleic acid sequence encoding an orthologue, paralogue or homologue of any of the polypeptide sequences given in Table E of Example 8.

The allelic variants useful in the methods of the present invention have substantially the same biological activity (i.e., enhancing yield-related traits) as the SWI2/SNF2 polypeptide of SEQ ID NO: 30 and any of the polypeptide sequences depicted in Table E of Example 8. Allelic variants exist in nature, and encompassed within the methods of the present invention is the use of these natural alleles. Preferably, the allelic variant is an allelic variant of SEQ ID NO: 29 or an allelic variant of a nucleic acid sequence encoding an orthologue or paralogue of SEQ ID NO: 30. Preferably, the polypeptide sequence encoded by the allelic variant comprises any one or more of the motifs or domains as defined herein. Preferably, the polypeptide sequence encoded by the allelic variant, when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7, tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30 rather than with any other SWI2/SNF2 clade.

Gene shuffling or directed evolution may also be used to generate variants of nucleic acid sequences encoding SWI2/SNF2 polypeptides as defined above; the term “gene shuffling” being as defined herein.

According to the present invention, there is provided a method for enhancing yield-related traits in plants, comprising introducing and expressing in a plant a variant of any one of the

nucleic acid sequences given in Table E of Example 8, or comprising introducing and expressing in a plant a variant of a nucleic acid sequence encoding an orthologue, paralogue or homologue of any of the polypeptide sequences given in Table E of Example 8, which variant nucleic acid sequence is obtained by gene shuffling.

The variant nucleic acid sequences obtained by gene shuffling useful in the methods of the present invention have substantially the same biological activity as the SWI2/SNF2 polypeptide of SEQ ID NO: 30 and any of the polypeptide sequences depicted in Table E of Example 8. Preferably, the variant nucleic acid sequence obtained by gene shuffling encodes a polypeptide sequence comprising any one or more of the motifs or domains as defined herein. Preferably, the polypeptide sequence encoded by the variant nucleic acid sequence obtained by gene shuffling, when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7, tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30 rather than with any other SWI2/SNF2 clade.

Furthermore, nucleic acid variants may also be obtained by site-directed mutagenesis. Several methods are available to achieve site-directed mutagenesis, the most common being PCR based methods (Current Protocols in Molecular Biology, Wiley Eds.).

Nucleic acid sequences encoding SWI2/SNF2 polypeptides may be derived from any natural or artificial source. The nucleic acid sequence may be modified from its native form in composition and/or genomic environment through deliberate human manipulation. Preferably the SWI2/SNF2 polypeptide-encoding nucleic acid sequence is from a microbial genome, further preferably from archea (such from as the following phyla: Crenarcheaota, Euryarchaeota (comprising Halobacteria, Methanobacteria, Methanococci, Methanopyri, Archaeoglobi, Thermoplasmata, and Thermococci classes), Korarchaeota, or Nanoarchaeota) or bacteria (such from as the following phyla: Actinobacteria, Aquificae, Bacteroidetes/Chlorobi, Chlamydiae, Chloroflexi, Chrysiogenetes, Cyanobacteria, Deferribacteres, Deinococcus-Thermus, Dictyoglomi, Fibrobacteres/Acidobacteria, Firmicutes, Fusobacteria, Gemmatimonadetes, Lentisphaerae, Nitrospirae, Planctomycetes, Proteobacteria, Spirochaetes, Thermodesulfobacteria, Thermomicrobia, Thermotogae, Verrucomicrobia), more preferably from cyanobacteria, such as *Synechocystis* sp., *Nostoc* sp., *Synechococcus* sp., *Prochlorococcus* sp., *Anaebena* sp., *Gloeobacter* sp., or *Thermosynechococcus* sp., more preferably from *Synechocystis* sp., most preferably from *Synechocystis sp*. PCC6803.

Performance of the methods of the invention gives plants having enhanced yield-related traits relative to control plants.

Reference herein to "enhanced yield-related traits" is taken to mean an increase in biomass (weight) of one or more parts of a plant, which may include aboveground (harvestable) parts and/or (harvestable) parts below ground. In particular, such harvestable parts are seeds, and performance of the methods of the invention results in plants having enhanced seed yield relative to control plants.

Taking corn as an example, a yield increase may be manifested as one or more of the following: increase in the number of plants established per hectare or acre, an increase in the number of ears per plant, an increase in the number of rows, number of kernels per row, kernel weight, thousand kernel weight, ear length/diameter, increase in the seed filling rate (which is the number of filled seeds divided by the total number of seeds and multiplied by 100), among others. Taking rice as an example, a yield increase may manifest itself as an increase in one or more of the following: number of plants per hectare or acre, number of panicles per plant, number of spikelets per panicle, number of flowers (florets) per panicle (which is expressed as a ratio of the number of filled seeds over the number of primary panicles), increase in the seed filling rate (which is the number of filled seeds divided by the total number of seeds and multiplied by 100), increase in thousand kernel weight, among others.

The present invention provides a method for enhancing yield-related traits of plants relative to control plants, which method comprises increasing expression in a plant of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined herein. Preferably, enhanced yield-related traits is one or more of: (i) increased number of flowers per panicle; (ii) increased total seed weight per plant; (iii) increased number of (filled) seeds; or (iv) increased harvest index.

Since the transgenic plants according to the present invention have enhanced yield-related traits, it is likely that these plants exhibit an increased growth rate (during at least part of their life cycle), relative to the growth rate of control plants at a corresponding stage in their life cycle. Besides the increased yield capacity, an increased efficiency of nutrient uptake may also contribute to the increase in yield. It is observed that the plants according to the present invention show a higher efficiency in nutrient uptake. Increased efficiency of nutrient uptake allows better growth of the plant, whether the plant is grown under stress or non-stress conditions.

The increased growth rate may be specific to one or more parts of a plant (including seeds), or may be throughout substantially the whole plant. Plants having an increased growth rate may have a shorter life cycle. The life cycle of a plant may be taken to mean the time needed to grow from a dry mature seed up to the stage where the plant has produced dry mature seeds, similar to the starting material. This life cycle may be influenced by factors such as early vigour, growth rate, greenness index, flowering time and speed of seed maturation. The increase in growth rate may take place at one or more stages in the life cycle of a plant or during substantially the whole plant life cycle. Increased growth rate during the early stages in the life cycle of a plant may reflect enhanced vigour. The increase in growth rate may alter the harvest cycle of a plant allowing plants to be sown later and/or harvested sooner than would otherwise be possible (a similar effect may be obtained with earlier flowering time). If the growth rate is sufficiently increased, it may allow for the further sowing of seeds of the same plant species (for example sowing and harvesting of rice plants followed by sowing and harvesting of further rice plants all within one conventional growing period). Similarly, if the growth rate is sufficiently increased, it may allow for the further sowing of seeds of different plants species (for example the sowing and harvesting of corn plants followed by, for example, the sowing and optional harvesting of soybean, potato or any other suitable plant). Harvesting additional times from the same rootstock in the case of some crop plants may also be possible. Altering the harvest cycle of a plant may lead to an increase in annual biomass production per acre (due to an increase in the number of times (say in a year) that any particular plant may be grown and harvested). An increase in growth rate may also allow for the cultivation of transgenic plants in a wider geographical area than their wild-type counterparts, since the territorial limitations for growing a crop are often determined by adverse environmental conditions either at the time of planting (early season) or at the time of harvesting (late season). Such adverse conditions may be avoided if the harvest cycle is shortened. The growth rate may be determined by deriving various parameters from growth curves, such parameters may be: T-Mid (the time taken for plants to reach 50% of their maximal size) and T-90 (time taken for plants to reach 90% of their maximal size), amongst others.

According to a preferred feature of the present invention, performance of the methods of the invention gives plants having an increased growth rate relative to control plants. Therefore, according to the present invention, there is provided a method for increasing the growth rate of plants, which method comprises increasing expression in a plant of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined herein.

An increase in yield and/or growth occurs whether the plant is grown under non-stress conditions or whether the plant is exposed to various stresses compared to control plants.

Plants typically respond to exposure to stress by growing more slowly. In conditions of severe stress, the plant may even stop growing altogether. Mild stress on the other hand is defined herein as being any stress to which a plant is exposed which does not result in the plant ceasing to grow altogether without the capacity to resume growth. Mild stress in the sense of the invention leads to a reduction in the growth of the stressed plants of less than 40%, 35% or 30%, preferably less than 25%, 20% or 15%, more preferably less than 14%, 13%, 12%, 11% or 10% or less in comparison to the control plant grown under non-stress conditions. Due to advances in agricultural practices (irrigation, fertilization, pesticide treatments) severe stresses are not often encountered in cultivated crop plants. As a consequence, the compromised growth induced by mild stress is often an undesirable feature for agriculture. Mild stresses are the everyday biotic and/or abiotic (environmental) stresses to which a plant is exposed. Abiotic stresses may be due to drought or excess water, anaerobic stress, salt stress, chemical toxicity, oxidative stress and hot, cold or freezing temperatures. The abiotic stress may be an osmotic stress caused by a water stress (particularly due to drought), salt stress, oxidative stress or an ionic stress. Biotic stresses are typically those stresses caused by pathogens, such as bacteria, viruses, fungi, nematodes, and insects. The term "non-stress" conditions as used herein are preferably those environmental conditions that do not significantly go beyond the everyday climatic and other abiotic conditions that plants may encounter most preferably those conditions that allow optimal growth of plants. Persons skilled in the art are aware of normal soil conditions and climatic conditions for a given location.

Performance of the methods of the invention gives plants grown under non-stress conditions or under mild drought conditions having enhanced yield-related traits relative to control plants grown under comparable stress conditions. Therefore, according to the present invention, there is provided a method for enhancing yield-related traits in plants grown under non-stress conditions or under mild drought conditions, which method comprises increasing expression in a plant of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined above.

Performance of the methods according to the present invention results in plants grown under abiotic stress conditions having enhanced yield-related traits relative to control plants grown under comparable stress conditions. As reported in Wang *et al.* (Planta (2003) 218: 1-14), abiotic stress leads to a series of morphological, physiological, biochemical and molecular changes that adversely affect plant growth and productivity. Drought, salinity, extreme temperatures and oxidative stress are known to be interconnected and may induce growth and cellular damage through similar mechanisms. For example, drought and/or salinisation are manifested primarily as osmotic stress, resulting in the disruption of homeostasis and ion distribution in the cell. Oxidative stress, which frequently accompanies high or low

temperature, salinity or drought stress may cause denaturation of functional and structural proteins. As a consequence, these diverse environmental stresses often activate similar cell signaling pathways and cellular responses, such as the production of stress proteins, up-regulation of anti-oxidants, accumulation of compatible solutes and growth arrest. Since diverse environmental stresses activate similar pathways, the exemplification of the present invention with drought stress should not be seen as a limitation to drought stress, but more as a screen to indicate the involvement of SWI2/SNF2 polypeptides as defined above, in enhancing yield-related traits relative to control plants grown in comparable stress conditions, in abiotic stresses in general.

A particularly high degree of "cross talk" is reported between drought stress and high-salinity stress (Rabbani *et al.* (2003) Plant Physiol 133: 1755-1767). Therefore, it would be apparent that an SWI2/SNF2 polypeptides would, along with their usefulness in enhancing yield-related traits in plants relative to control plants grown under drought stress conditions, also find use in enhancing yield-related traits in plants, relative to control plants grown under various other abiotic stress conditions.

The term "abiotic stress" as defined herein is taken to mean any one or more of: water stress (due to drought or excess water), anaerobic stress, salt stress, temperature stress (due to hot, cold or freezing temperatures), chemical toxicity stress and oxidative stress. According to one aspect of the invention, the abiotic stress is an osmotic stress, selected from water stress, salt stress, oxidative stress and ionic stress. Preferably, the water stress is drought stress. The term salt stress is not restricted to common salt (NaCl), but may be any one or more of: NaCl, KCl, LiCl, $MgCl_2$, $CaCl_2$, amongst others.

In particular, the enhanced yield-related traits in plants grown under abiotic stress conditions (preferably under drought stress conditions) relative to control plants grown in comparable stress conditions, may include one or more of the following: (i) increased aboveground area; (ii) increased total root biomass; (iii) increased thick root biomass; (iv) increased thin root biomass; (v) increased number of flowers per panicle; (vi) increased seed fill rate; (vii) increased total seed weight per plant; (viii) increased number of (filled) seeds; or (ix) increased harvest index.

Performance of the methods of the invention gives plants having enhanced yield-related traits under abiotic stress conditions relative to control plants grown in comparable stress conditions. Therefore, according to the present invention, there is provided a method for enhanced yield-related traits in plants grown under abiotic stress conditions, which method comprises

increasing expression in a plant of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide. According to one aspect of the invention, the abiotic stress is an osmotic stress, selected from one or more of the following: water stress, salt stress, oxidative stress and ionic stress. Preferably, the water stress is drought stress.

Another example of abiotic environmental stress is the reduced availability of one or more nutrients that need to be assimilated by the plants for growth and development. Because of the strong influence of nutrition utilization efficiency on plant yield and product quality, a huge amount of fertilizer is poured onto fields to optimize plant growth and quality. Productivity of plants ordinarily is limited by three primary nutrients, phosphorous, potassium and nitrogen, which is usually the rate-limiting element in plant growth of these three. Therefore the major nutritional element required for plant growth is nitrogen (N). It is a constituent of numerous important compounds found in living cells, including amino acids, proteins (enzymes), nucleic acids, and chlorophyll. 1.5% to 2% of plant dry matter is nitrogen and approximately 16% of total plant protein. Thus, nitrogen availability is a major limiting factor for crop plant growth and production (Frink et al. (1999) Proc Natl Acad Sci USA 96(4): 1175-1180), and has as well a major impact on protein accumulation and amino acid composition. Therefore, of great interest are crop plants with an increased yield when grown under nitrogen-limiting conditions.

The present invention encompasses plants, parts thereof (including seeds), or plant cells obtainable by the methods according to the present invention. The plants, plant parts or plant cells comprise an isolated nucleic acid transgene encoding an SWI2/SNF2 polypeptide as defined above.

The invention also provides genetic constructs and vectors to facilitate introduction and/or expression in plants of nucleic acid sequences encoding SWI2/SNF2 polypeptides. The gene constructs may be inserted into vectors, which may be commercially available, suitable for transforming into plants and suitable for expression of the gene of interest in the transformed cells. The invention also provides use of a gene construct as defined herein in the methods of the invention.

More specifically, the present invention provides a construct comprising:

(d) a nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined above;

(e) one or more control sequences capable of driving expression of the nucleic acid sequence of (a); and optionally

(f) a transcription termination sequence.

The term "control sequence" and "termination sequence" are as defined herein.

In one embodiment, one of the control sequences of a construct is a tissue-specific promoter, preferably a promoter for expression in young expanding tissues. An example of a tissue-specific promoter for expression in young expanding tissues is a beta-expansin promoter, for example a rice beta-expansin promoter as represented by SEQ ID NO: 112.

Plants are transformed with a vector comprising any of the nucleic acid sequences described above. The skilled artisan is well aware of the genetic elements that must be present on the vector in order to successfully transform, select and propagate host cells containing the sequence of interest. The sequence of interest is operably linked to one or more control sequences (at least to a promoter).

Advantageously, any type of promoter may be used to drive expression of the nucleic acid sequence. The promoter may be a constitutive promoter, which refers to a promoter that is transcriptionally active during most, but not necessarily all, phases of its growth and development and under most environmental conditions, in at least one cell, tissue or organ. Alternatively, the promoter may be an inducible promoter, i.e. having induced or increased transcription initiation in response to a chemical (for a review see Gatz 1997, Annu. Rev. Plant Physiol. Plant Mol. Biol., 48:89-108), environmental or physical stimulus. Another example of an inducible promoter is a stress-inducible promoter, i.e. a promoter activated when a plant is exposed to various stress conditions, or a pathogen-induced promoter.

Additionally or alternatively, the promoter may be an organ-specific or tissue-specific promoter, i.e. one that is capable of preferentially initiating transcription in certain organs or tissues, such as the leaves, roots, seed tissue etc; or the promoter may be a ubiquitous promoter, which is active in substantially all tissues or cells of an organism, or the promoter may be developmentally regulated, thereby being active during certain developmental stages or in parts of the plant that undergo developmental changes. Promoters able to initiate transcription in certain organs or tissues only are referred to herein as "organ-specific" or "tissue-specific" respectively, similarly, promoters able to initiate transcription in certain cells only are referred to herein as "cell-specific".

In one embodiment, a nucleic acid sequence encoding SWI2/SNF2 polypeptide as defined above, such as the nucleic acid sequence as represented by SEQ ID NO: 29, is operably linked to a tissue-specific promoter, preferably to a promoter capable of preferentially expressing the nucleic acid sequence in young expanding tissues, or in the apical meristem.

Preferably, the promoter capable of preferentially expressing the nucleic acid sequence in young expanding tissues has a comparable expression profile to a beta-expansin promoter. More specifically, the promoter capable of preferentially expressing the nucleic acid sequence in young expanding tissues is a promoter capable of driving expression in the cell expansion zone of a shoot or root. Most preferably, the promoter capable of preferentially expressing the nucleic acid sequence in young expanding tissues is a beta-expansin promoter, for example a rice beta-expansin promoter as represented by SEQ ID NO: 112.

For the identification of functionally equivalent promoters, the promoter strength and/or expression pattern of a candidate promoter may be analysed for example by operably linking the promoter to a reporter gene and assaying the expression level and pattern of the reporter gene in various tissues of the plant. Suitable well-known reporter genes include for example beta-glucuronidase or beta galactosidase. The promoter activity is assayed by measuring the enzymatic activity of the beta-glucuronidase or beta-galactosidase. The promoter strength and/or expression pattern may then be compared to that of a reference promoter (such as the one used in the methods of the present invention). Alternatively, promoter strength may be assayed by quantifying mRNA levels or by comparing mRNA levels of the nucleic acid sequence used in the methods of the present invention, with mRNA levels of housekeeping genes such as 18S rRNA, using methods known in the art, such as Northern blotting with densitometric analysis of autoradiograms, quantitative real-time PCR or RT-PCR (Heid et al., 1996 Genome Methods 6: 986-994). Generally by "weak promoter" is intended a promoter that drives expression of a coding sequence at a low level. By "low level" is intended at levels of about 1/10,000 transcripts to about 1/100,000 transcripts, to about 1/500,0000 transcripts per cell. Conversely, a "strong promoter" drives expression of a coding sequence at high level, or at about 1/10 transcripts to about 1/100 transcripts to about 1/1,000 transcripts per cell.

Optionally, one or more terminator sequences may be used in the construct introduced into a plant. Additional regulatory elements may include transcriptional as well as translational enhancers. Those skilled in the art will be aware of terminator and enhancer sequences that may be suitable for use in performing the invention. Such sequences would be known or may readily be obtained by a person skilled in the art.

An intron sequence may also be added to the 5' untranslated region (UTR) or in the coding sequence to increase the amount of the mature message that accumulates in the cytosol. Inclusion of a spliceable intron in the transcription unit in both plant and animal expression constructs has been shown to increase gene expression at both the mRNA and protein levels up to 1000-fold (Buchman and Berg, Mol. Cell Biol. 8:4395-4405 (1988); Callis et al., Genes

Dev. 1:1183-1200 (1987)). Such intron enhancement of gene expression is typically greatest when placed near the 5' end of the transcription unit. Use of the maize introns Adh1-S intron 1, 2, and 6, the Bronze-1 intron are known in the art. For general information, see The Maize Handbook, Chapter 116, Freeling and Walbot, Eds., Springer, N.Y. (1994).

Other control sequences (besides promoter, enhancer, silencer, intron sequences, 3'UTR and/or 5'UTR regions) may be protein and/or RNA stabilizing elements. Such sequences would be known or may readily be obtained by a person skilled in the art.

The genetic constructs of the invention may further include an origin of replication sequence that is required for maintenance and/or replication in a specific cell type. One example is when a genetic construct is required to be maintained in a bacterial cell as an episomal genetic element (e.g. plasmid or cosmid molecule). Preferred origins of replication include, but are not limited to, the f1-ori and colE1.

For the detection of the successful transfer of the nucleic acid sequences as used in the methods of the invention and/or selection of transgenic plants comprising these nucleic acid sequences, it is advantageous to use marker genes (or reporter genes). Therefore, the genetic construct may optionally comprise a selectable marker gene. Selectable markers are described in more detail in the “definitions” section herein.

It is known that upon stable or transient integration of nucleic acid sequences into plant cells, only a minority of the cells takes up the foreign DNA and, if desired, integrates it into its genome, depending on the expression vector used and the transfection technique used. To identify and select these integrants, a gene coding for a selectable marker (such as the ones described above) is usually introduced into the host cells together with the gene of interest. These markers can for example be used in mutants in which these genes are not functional by, for example, deletion by conventional methods. Furthermore, nucleic acid sequences encoding a selectable marker can be introduced into a host cell on the same vector that comprises the sequence encoding the polypeptides of the invention or used in the methods of the invention, or else in a separate vector. Cells which have been stably transfected with the introduced nucleic acid sequence can be identified for example by selection (for example, cells which have integrated the selectable marker survive whereas the other cells die).

Since the marker genes, particularly genes for resistance to antibiotics and herbicides, are no longer required or are undesired in the transgenic host cell once the nucleic acid sequences have been introduced successfully, the process according to the invention for introducing the

nucleic acid sequences advantageously employs techniques, which enable the removal or excision of these marker genes. One such a method is what is known as co-transformation. The co-transformation method employs two vectors simultaneously for the transformation, one vector bearing the nucleic acid sequence according to the invention and a second bearing the marker gene(s). A large proportion of transformants receives or, in the case of plants, comprises (up to 40% or more of the transformants), both vectors. In case of transformation with Agrobacteria, the transformants usually receive only a part of the vector, i.e. the sequence flanked by the T-DNA, which usually represents the expression cassette. The marker genes can subsequently be removed from the transformed plant by performing crosses. In another method, marker genes integrated into a transposon are used for the transformation together with desired nucleic acid sequence (known as the Ac/Ds technology). The transformants can be crossed with a transposase source or the transformants are transformed with a nucleic acid construct conferring expression of a transposase, transiently or stable. In some cases (approx. 10%), the transposon jumps out of the genome of the host cell once transformation has taken place successfully and is lost. In a further number of cases, the transposon jumps to a different location. In these cases the marker gene must be eliminated by performing crosses. In microbiology, techniques were developed which make possible, or facilitate, the detection of such events. A further advantageous method relies on what is known as recombination systems; whose advantage is that elimination by crossing can be dispensed with. The best-known system of this type is what is known as the Cre/lox system. Cre1 is a recombinase that removes the sequences located between the loxP sequences. If the marker gene is integrated between the loxP sequences, it is removed once transformation has taken place successfully, by expression of the recombinase. Further recombination systems are the HIN/HIX, FLP/FRT and REP/STB system (Tribble et al., J. Biol. Chem., 275, 2000: 22255-22267; Velmurugan et al., J. Cell Biol., 149, 2000: 553-566). A site-specific integration into the plant genome of the nucleic acid sequences according to the invention is possible. Naturally, these methods can also be applied to microorganisms such as yeast, fungi or bacteria.

The invention also provides a method for the production of transgenic plants having enhanced yield-related traits relative to control plants, comprising introduction and expression in a plant of any nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined hereinabove.

More specifically, the present invention provides a method for the production of transgenic plants having enhanced yield-related traits relative to control plants, which method comprises:

(i) introducing and expressing in a plant or plant cell a nucleic acid sequence encoding an SWI2/SNF2 polypeptide; and

(ii) cultivating the plant cell under conditions promoting plant growth and development.

The nucleic acid sequence may be introduced directly into a plant cell or into the plant itself (including introduction into a tissue, organ or any other part of a plant). According to a preferred feature of the present invention, the nucleic acid sequence is preferably introduced into a plant by transformation. The term "transformation" is described in more detail in the "definitions" section herein.

The genetically modified plant cells can be regenerated via all methods with which the skilled worker is familiar. Suitable methods can be found in the abovementioned publications by S.D. Kung and R. Wu, Potrykus or Höfgen and Willmitzer.

Generally after transformation, plant cells or cell groupings are selected for the presence of one or more markers which are encoded by plant-expressible genes co-transferred with the gene of interest, following which the transformed material is regenerated into a whole plant. To select transformed plants, the plant material obtained in the transformation is, as a rule, subjected to selective conditions so that transformed plants can be distinguished from untransformed plants. For example, the seeds obtained in the above-described manner can be planted and, after an initial growing period, subjected to a suitable selection by spraying. A further possibility consists in growing the seeds, if appropriate after sterilization, on agar plates using a suitable selection agent so that only the transformed seeds can grow into plants. Alternatively, the transformed plants are screened for the presence of a selectable marker such as the ones described above.

Following DNA transfer and regeneration, putatively transformed plants may also be evaluated, for instance using Southern analysis or quantitative PCR, for the presence of the gene of interest, copy number and/or genomic organisation. Alternatively or additionally, expression levels of the newly introduced DNA may be monitored using Northern and/or Western analysis, both techniques being well known to persons having ordinary skill in the art.

The generated transformed plants may be propagated by a variety of means, such as by clonal propagation or classical breeding techniques. For example, a first generation (or T1) transformed plant may be selfed and homozygous second-generation (or T2) transformants selected, and the T2 plants may then further be propagated through classical breeding techniques.

The generated transformed organisms may take a variety of forms. For example, they may be chimeras of transformed cells and non-transformed cells; clonal transformants (e.g., all cells

transformed to contain the expression cassette); grafts of transformed and untransformed tissues (e.g., in plants, a transformed rootstock grafted to an untransformed scion).

The present invention clearly extends to any plant cell or plant produced by any of the methods described herein, and to all plant parts and propagules thereof. The present invention extends further to encompass the progeny of a primary transformed or transfected cell, tissue, organ or whole plant that has been produced by any of the aforementioned methods, the only requirement being that progeny exhibit the same genotypic and/or phenotypic characteristic(s) as those produced by the parent in the methods according to the invention.

The invention also includes host cells containing an isolated nucleic acid sequence encoding an SWI2/SNF2 polypeptide as defined hereinabove. Preferred host cells according to the invention are plant cells. Host plants for the nucleic acid sequences or the vector used in the method according to the invention, the expression cassette or construct or vector are, in principle, advantageously all plants, which are capable of synthesizing the polypeptides used in the inventive method.

The methods of the invention are advantageously applicable to any plant.

Plants that are particularly useful in the methods of the invention include all plants which belong to the superfamily Viridiplantae, in particular monocotyledonous and dicotyledonous plants including fodder or forage legumes, ornamental plants, food crops, trees or shrubs. According to a preferred embodiment of the present invention, the plant is a crop plant. Examples of crop plants include soybean, sunflower, canola, alfalfa, rapeseed, cotton, tomato, potato and tobacco. Further preferably, the plant is a monocotyledonous plant. Examples of monocotyledonous plants include sugarcane. More preferably the plant is a cereal. Examples of cereals include rice, maize, wheat, barley, millet, rye, triticale, sorghum and oats.

The invention also extends to harvestable parts of a plant such as, but not limited to seeds, leaves, fruits, flowers, stems, rhizomes, tubers and bulbs. The invention furthermore relates to products derived, preferably directly derived, from a harvestable part of such a plant, such as dry pellets or powders, oil, fat and fatty acids, starch or proteins.

Methods for increasing expression of nucleic acid sequences or genes, or gene products, are well documented in the art and include, for example, overexpression driven by appropriate promoters, the use of transcription enhancers or translation enhancers. Isolated nucleic acid sequences which serve as promoter or enhancer elements may be introduced in an appropriate position (typically upstream) of a non-heterologous form of a polynucleotide so as

to upregulate expression. For example, endogenous promoters may be altered in vivo by mutation, deletion, and/or substitution (see, Kmiec, U.S. Pat. No. 5,565,350; Zarling et al., PCT/US93/03868), or isolated promoters may be introduced into a plant cell in the proper orientation and distance from a gene of the present invention so as to control the expression of the gene.

If polypeptide expression is desired, it is generally desirable to include a polyadenylation region at the 3'-end of a polynucleotide coding region. The polyadenylation region can be derived from the natural gene, from a variety of other plant genes, or from T-DNA. The 3' end sequence to be added may be derived from, for example, the nopaline synthase or octopine synthase genes, or alternatively from another plant gene, or less preferably from any other eukaryotic gene.

As mentioned above, a preferred method for increasing expression of a nucleic acid sequence encoding an SWI2/SNF2 polypeptide is by introducing and expressing in a plant a nucleic acid sequence encoding an SWI2/SNF2 polypeptide; however the effects of performing the method, i.e. enhancing yield-related traits, may also be achieved using other well known techniques. A description of some of these techniques will now follow.

One such technique is T-DNA activation tagging (Hayashi et al. Science (1992) 1350-1353), which involves insertion of T-DNA, usually containing a promoter (may also be a translation enhancer or an intron), in the genomic region of the gene of interest or 10 kb up- or downstream of the coding region of a gene in a configuration such that the promoter directs expression of the targeted gene. Typically, regulation of expression of the targeted gene by its natural promoter is disrupted and the gene falls under the control of the newly introduced promoter. The promoter is typically embedded in a T-DNA. This T-DNA is randomly inserted into the plant genome, for example, through Agrobacterium infection and leads to modified expression of genes near the inserted T-DNA. The resulting transgenic plants show dominant phenotypes due to modified expression of genes close to the introduced promoter.

The effects of the invention may also be reproduced using the technique of TILLING (Targeted Induced Local Lesions In Genomes); for a description of the same see the “definitions” section.

The effects of the invention may also be reproduced using homologous recombination; for a description of the same see the “definitions” section.

The present invention also encompasses use of nucleic acid sequences encoding SWI2/SNF2 polypeptides as described herein and use of these SWI2/SNF2 polypeptides in enhancing yield-related traits in plants relative to control plants. Preferably, enhanced yield-related traits is one or more of: (i) increased number of flowers per panicle; (ii) increased total seed weight per plant; (iii) increased number of (filled) seeds; or (iv) increased harvest index.

The present invention further encompasses use of nucleic acid sequences encoding SWI2/SNF2 polypeptides as described herein and use of these SWI2/SNF2 polypeptides in enhancing yield-related traits in plants grown under abiotic stress conditions (preferably under drought stress conditions), relative to control plants grown under comparable stress conditions. Preferably, enhanced yield-related traits are one or more of: (i) increased aboveground area; (ii) increased total root biomass; (iii) increased thick root biomass; (iv) increased thin root biomass; (v) increased number of flowers per panicle; (vi) increased seed fill rate; (vii) increased total seed weight per plant; (viii) increased number of (filled) seeds; or (ix) increased harvest index.

Nucleic acid sequences encoding SWI2/SNF2 polypeptides described herein, or the SWI2/SNF2 polypeptides themselves, may find use in breeding programmes in which a DNA marker is identified, which may be genetically linked to a gene encoding an SWI2/SNF2 polypeptide. The genes/nucleic acid sequences or the SWI2/SNF2 polypeptides themselves may be used to define a molecular marker. This DNA or protein marker may then be used in breeding programmes to select plants having enhanced yield-related traits as defined hereinabove in the methods of the invention.

Allelic variants of a gene/nucleic acid sequence encoding an SWI2/SNF2 polypeptide may also find use in marker-assisted breeding programmes. Such breeding programmes sometimes require introduction of allelic variation by mutagenic treatment of the plants, using for example EMS mutagenesis; alternatively, the programme may start with a collection of allelic variants of so called “natural” origin caused unintentionally. Identification of allelic variants then takes place, for example, by PCR. This is followed by a step for selection of superior allelic variants of the sequence in question and which give enhanced yield-related traits. Selection is typically carried out by monitoring growth performance of plants containing different allelic variants of the sequence in question. Growth performance may be monitored in a greenhouse or in the field. Further optional steps include crossing plants in which the superior allelic variant was identified with another plant. This could be used, for example, to make a combination of interesting phenotypic features.

Nucleic acid sequences encoding SWI2/SNF2 polypeptides may also be used as probes for genetically and physically mapping the genes that they are a part of, and as markers for traits linked to those genes. Such information may be useful in plant breeding in order to develop lines with desired phenotypes. Such use of nucleic acid sequences encoding an SWI2/SNF2 polypeptide requires only a nucleic acid sequence of at least 15 nucleotides in length. The nucleic acid sequences encoding an SWI2/SNF2 polypeptide may be used as restriction fragment length polymorphism (RFLP) markers. Southern blots (Sambrook J, Fritsch EF and Maniatis T (1989) Molecular Cloning, A Laboratory Manual) of restriction-digested plant genomic DNA may be probed with nucleic acid sequences encoding the SWI2/SNF2 polypeptide. The resulting banding patterns may then be subjected to genetic analyses using computer programs such as MapMaker (Lander et al. (1987) Genomics 1: 174-181) in order to construct a genetic map. In addition, the nucleic acid sequences may be used to probe Southern blots containing restriction endonuclease-treated genomic DNAs of a set of individuals representing parent and progeny of a defined genetic cross. Segregation of the DNA polymorphisms is noted and used to calculate the position of the nucleic acid sequence encoding the SWI2/SNF2 polypeptide in the genetic map previously obtained using this population (Botstein et al. (1980) Am. J. Hum. Genet. 32:314-331).

The production and use of plant gene-derived probes for use in genetic mapping is described in Bernatzky and Tanksley (1986) Plant Mol. Biol. Reporter 4: 37-41. Numerous publications describe genetic mapping of specific cDNA clones using the methodology outlined above or variations thereof. For example, F2 intercross populations, backcross populations, randomly mated populations, near isogenic lines, and other sets of individuals may be used for mapping. Such methodologies are well known to those skilled in the art.

The nucleic acid probes may also be used for physical mapping (i.e., placement of sequences on physical maps; see Hoheisel et al. In: Non-mammalian Genomic Analysis: A Practical Guide, Academic press 1996, pp. 319-346, and references cited therein).

In another embodiment, the nucleic acid probes may be used in direct fluorescence in situ hybridisation (FISH) mapping (Trask (1991) Trends Genet. 7:149-154). Although current methods of FISH mapping favour use of large clones (several kb to several hundred kb; see Laan et al. (1995) Genome Res. 5:13-20), improvements in sensitivity may allow performance of FISH mapping using shorter probes.

A variety of nucleic acid amplification-based methods for genetic and physical mapping may be carried out using the nucleic acid sequences. Examples include allele-specific amplification

(Kazazian (1989) J. Lab. Clin. Med 11:95-96), polymorphism of PCR-amplified fragments (CAPS; Sheffield et al. (1993) Genomics 16:325-332), allele-specific ligation (Landegren et al. (1988) Science 241:1077-1080), nucleotide extension reactions (Sokolov (1990) Nucleic Acid Res. 18:3671), Radiation Hybrid Mapping (Walter et al. (1997) Nat. Genet. 7:22-28) and Happy Mapping (Dear and Cook (1989) Nucleic Acid Res. 17:6795-6807). For these methods, the sequence of a nucleic acid is used to design and produce primer pairs for use in the amplification reaction or in primer extension reactions. The design of such primers is well known to those skilled in the art. In methods employing PCR-based genetic mapping, it may be necessary to identify DNA sequence differences between the parents of the mapping cross in the region corresponding to the instant nucleic acid sequence. This, however, is generally not necessary for mapping methods.

The methods according to the present invention result in plants having enhanced yield-related traits relative to control plants, as described hereinbefore. This trait may also be combined with other economically advantageous traits, such as further yield-enhancing traits (under normal or stress growth conditions), tolerance to other abiotic and biotic stresses, traits modifying various architectural features and/or biochemical and/or physiological features.

Description of figures

The present invention will now be described with reference to the following figures in which:

Fig. 1 shows an alignment of HpaG polypeptides with motifs 1 and 2 indicated in bold and underlined for SEQ ID NO: 2.

Fig. 2 shows a phylogenetic tree with the group of HpaG polypeptides delineated from other bacterial and from plant proteins (the various sequences are indicated by their GenBank accession numbers and/or gi numbers).

Fig. 3 shows the binary vector for increased expression in *Oryza sativa* of an HpaG protein-encoding nucleic acid from *Xanthomonas* under the control of a rice GOS2 promoter (pGOS2).

Fig. 4 details examples of Harpin sequences useful in performing the methods according to the present invention.

Fig. 5 shows a scheme of the structure of SWI2/SNF2 polypeptides useful in performing the methods of the invention. The SWI2/SNF2 polypeptides useful in performing the methods of the invention comprise an N-terminal domain and an ATPase domain, both marked as an open

box. The typical 8 motifs I, Ia, II, III, IV, V, Va and VI comprised in the ATPase domain of the SWI2/SNF2 polypeptides useful in performing the methods of the invention are marked as black vertical lines.

Fig. 6 shows the sequence logo of the ATPase domain of the 149 SWI2/SNF2 SSO1653 subfamily members as in Flaus *et al.,* (2006). The ATPase domain as represented by SEQ ID NO: 111, and comprised in SEQ ID NO: 30, is in accordance with this sequence logo.

Fig. 7 shows an unrooted radial neighbor-joining tree of SWI2/SNF2 polypeptides from numerous SWI2/SNF2 subfamilies (including the 149 SWI2/SNF2 SSO1653 subfamily members) constructed by Flaus *et al.,* (2006). The polypeptide as represented by SEQ ID NO: 30 is comprised within the SSO1653 cluster (circled in the Figure), together with all the archeal and bacterial (collectively called microbial) SWI2/SNF2 polypeptides.

Fig. 8 shows a CLUSTAL W (1;83) multiple sequence alignment of SWI2/SNF2 polypeptides from various microbes, using default values. SWI2/SNF2 polypeptides share sequence conservation essentially in Motifs I, Ia, II, III, IV, V, Va and VI, comprised in the ATPase domain. These are boxed and identified as such. Another feature that is highlighted is the ATPase domain, for example as represented by SEQ ID NO: 111, comprised in SEQ ID NO: 30. The ATPase domain is comprised (from N to C-terminus) between the first amino acid residue of Motif 1 and the last amino acid residue at the C-terminus of the SWI2/SNF2 polypeptide. The beginning and the end of the ATPase domain are marked, and the ATPase domain itself is identified using a black block above the aligned polypeptides.

Fig. 9 shows the binary vector for increased expression in *Oryza sativa* of a *Synechocystis* sp. PCC6803 nucleic acid sequence encoding a SWI2/SNF2 polypeptide under the control of a beta-expansin promoter.

Fig. 10 details examples of SNF2 sequences useful in performing the methods according to the present invention.

Examples

The present invention will now be described with reference to the following examples, which are by way of illustration alone. The following examples are not intended to completely define or otherwise limit the scope of the invention.

Example 1: Identification of HpaG sequences

Sequences (full length cDNA, ESTs or genomic) related to SEQ ID NO: 1 and/or protein sequences related to SEQ ID NO: 2 were identified amongst those maintained in the Entrez Nucleotides database at the National Center for Biotechnology Information (NCBI) using database sequence search tools, such as the Basic Local Alignment Tool (BLAST) (Altschul *et al.* (1990) J. Mol. Biol. 215:403-410; and Altschul *et al.* (1997) Nucleic Acids Res. 25:3389-3402). The program was used to find regions of local similarity between sequences by comparing nucleic acid or polypeptide sequences to sequence databases and by calculating the statistical significance of matches. The polypeptide encoded by SEQ ID NO: 1 was used for the TBLASTN algorithm, with default settings and the filter to ignore low complexity sequences set off. The output of the analysis was viewed by pairwise comparison, and ranked according to the probability score (E-value), where the score reflects the probability that a particular alignment occurs by chance (the lower the E-value, the more significant the hit). In addition to E-values, comparisons were also scored by percentage identity. Percentage identity refers to the number of identical nucleotides (or amino acids) between the two compared nucleic acid (or polypeptide) sequences over a particular length. In some instances, the default parameters may be adjusted to modify the stringency of the search.

Table A provides a list of nucleic acid and protein sequences related to the nucleic acid sequence as represented by SEQ ID NO: 1 and the protein sequence represented by SEQ ID NO: 2.

Table A: HpaG-encoding nucleic acid sequences and HpaG polypeptides useful in the methods of the present invention.

Name	**Source organism**	**Nucleic acid SEQ ID NO:**	**Polypeptide SEQ ID NO:**	**Status**
HpaG	Xanthomonas axonopodis	1	2	Full length
HpaG_T44C	Synthetic construct	7	8	Full length
HpaG-T	Synthetic construct	9	10	Full length
Hpa1	Xanthomonas axonopodis pv. citri str. 306	11	12	Full length
HpaG-N	Synthetic construct	13	14	Full length
HpaG_G	Xanthomonas axonopodis	15	16	Full length
Hrp	Xanthomonas smithii subsp. smithii	17	18	Full length
hypersensitive response-functioning factor A	Xanthomonas oryzae pv. oryzae strain JXOIII	19	20	Full length
Hpa1	Xanthomonas oryzae pv. oryzae	21	22	Full length
Hpa1	Xanthomonas oryzae pv. oryzae	23	24	Full length

hpaGXooc	Xanthomonas oryzae pv. oryzicola	25	26	Full length
Hpa1	Xanthomonas campestris pv. campestris str. ATCC 33913	27	28	Full length

Example 2: Alignment of HpaG polypeptide sequences

Alignment of polypeptide sequences (Figure 1) was performed using the ClustalW programme which is based on the popular Clustal algorithm of progressive alignment (Thompson *et al.* (1997) Nucleic Acids Res 25:4876-4882; Chenna *et al.* (2003). Nucleic Acids Res 31:3497-3500). Default values are for the gap open penalty of 10, for the gap extension penalty of 0,1 and the selected weight matrix is Blosum 62 (if polypeptides are aligned). Minor manual editing was done to further optimise the alignment.

A phylogenetic tree of HpaG polypeptides (Figure 2) was constructed using a neighbour-joining clustering algorithm as provided in the AlignX programme from the Vector NTI (Invitrogen).

Example 3: Calculation of global percentage identity between polypeptide sequences useful in performing the methods of the invention

Global percentages of similarity and identity between full length polypeptide sequences useful in performing the methods of the invention were determined using one of the methods available in the art, the MatGAT (Matrix Global Alignment Tool) software (Campanella et al., BMC Bioinformatics. 2003 4:29. MatGAT: an application that generates similarity/identity matrices using protein or DNA sequences). MatGAT software generates similarity/identity matrices for DNA or protein sequences without needing pre-alignment of the data. The program performs a series of pair-wise alignments using the Myers and Miller global alignment algorithm (with a gap opening penalty of 12, and a gap extension penalty of 2), calculates similarity and identity using for example Blosum 62 (for polypeptides), and then places the results in a distance matrix. Sequence similarity is shown in the bottom half of the dividing line and sequence identity is shown in the top half of the diagonal dividing line.

Parameters used in the comparison were:

Scoring matrix: Blosum62

First Gap: 12

Extending gap: 2

Results of the software analysis are shown in Table B for the global similarity and identity over the full length of the polypeptide sequences (excluding the partial polypeptide sequences).

Percentage identity is given above the diagonal in bold and percentage similarity is given below the diagonal (normal face).

The percentage identity between the HpaG polypeptide sequences useful in performing the methods of the invention can be as low as 37 % amino acid identity compared to SEQ ID NO: 9.

Table B: MatGAT results for global similarity and identity over the full length of the polypeptide sequences.

	1	2	3	4	5	6	7	8	9	10	11	12
1. SEQ ID NO: 2		**99.2**	**94.0**	**91.2**	**91.0**	**90.2**	**85.4**	**66.7**	**66.7**	**66.7**	**59.6**	**37.7**
2. ABK51589	99.2		**93.2**	**90.5**	**90.2**	**89.5**	**84.7**	**67.4**	**67.4**	**67.4**	**60.3**	**37.7**
3. ABK51587	94.0	93.2		**85.4**	**85.0**	**92.0**	**79.6**	**60.3**	**60.3**	**60.3**	**56.4**	**33.3**
4. AAM35307	92.0	91.2	86.1		**82.5**	**81.8**	**89.8**	**70.9**	**70.9**	**70.9**	**61.4**	**36.6**
5. ABK51590	91.0	90.2	90.4	83.2		**81.2**	**76.6**	**57.4**	**57.4**	**57.4**	**50.7**	**32.8**
6. ABK51588	90.2	89.5	92.0	82.5	89.3		75.2	**58.2**	**58.2**	**58.2**	**56.4**	**33.8**
7. ABG36696	89.5	88.7	83.5	92.7	80.5	79.7		**70.7**	**70.7**	**70.7**	**58.8**	**37.0**
8. ABJ97680	77.0	77.7	70.5	80.6	67.6	68.3	81.3		**100.0**	**100.0**	**64.5**	**35.0**
9. AAC95121	77.0	77.7	70.5	80.6	67.6	68.3	81.3	100.0		**100.0**	**64.5**	**35.0**
10. BAD29979	77.0	77.7	70.5	80.6	67.6	68.3	81.3	100.0	100.0		**64.5**	**35.0**
11. ABB72197	72.9	73.7	72.8	73.7	68.0	72.8	72.9	72.7	72.7	72.7		**34.6**
12. AAM40538	51.9	51.9	48.0	49.6	46.3	50.4	50.4	45.3	45.3	45.3	53.6	

Example 4: Cloning and vector construction

Unless otherwise stated, recombinant DNA techniques are performed according to standard protocols described in (Sambrook (2001) Molecular Cloning: a laboratory manual, 3rd Edition Cold Spring Harbor Laboratory Press, CSH, New York) or in Volumes 1 and 2 of Ausubel et al. (1994), Current Protocols in Molecular Biology, Current Protocols. Standard materials and methods for plant molecular work are described in Plant Molecular Biology Labfax (1993) by R.D.D. Croy, published by BIOS Scientific Publications Ltd (UK) and Blackwell Scientific Publications (UK).

The *Xanthomonas* HpaG coding sequence was amplified by PCR from a *Xanthomonas axonopodis* DNA library. The PCR fragment of the expected length was purified and subsequently cloned in a Gateway® vector using standard technology. The entry clone comprising SEQ ID NO: 1 was then used in an LR reaction with a destination vector used for *Oryza sativa* transformation. This vector contained as functional elements within the T-DNA

borders: a plant selectable marker; a screenable marker expression cassette; and a Gateway cassette intended for LR *in vivo* recombination with the nucleic acid sequence of interest already cloned in the entry clone. A rice GOS2 promoter (SEQ ID NO: 5) for constitutive expression was located upstream of this Gateway cassette. Alternatively, a green tissue specific promoter, such as the protochlorophyllide reductase promoter (SEQ ID NO: 6), was shown to be equally useful.

After the LR recombination step, the resulting expression vector pGOS2::HpaG was transformed into *Agrobacterium* strain LBA4044 according to methods well known in the art.

Example 5: Plant transformation

Rice transformation

The *Agrobacterium* containing the expression vector was used to transform *Oryza sativa* plants. Mature dry seeds of the rice japonica cultivar Nipponbare were dehusked. Sterilization was carried out by incubating for one minute in 70% ethanol, followed by 30 minutes in 0.2%$HgCl_2$, followed by a 6 times 15 minutes wash with sterile distilled water. The sterile seeds were then germinated on a medium containing 2,4-D (callus induction medium). After incubation in the dark for four weeks, embryogenic, scutellum-derived calli were excised and propagated on the same medium. After two weeks, the calli were multiplied or propagated by subculture on the same medium for another 2 weeks. Embryogenic callus pieces were sub-cultured on fresh medium 3 days before co-cultivation (to boost cell division activity).

Agrobacterium strain LBA4404 containing the expression vector was used for co-cultivation. *Agrobacterium* was inoculated on AB medium with the appropriate antibiotics and cultured for 3 days at 28°C. The bacteria were then collected and suspended in liquid co-cultivation medium to a density (OD_{600}) of about 1. The suspension was then transferred to a Petri dish and the calli immersed in the suspension for 15 minutes. The callus tissues were then blotted dry on a filter paper and transferred to solidified, co-cultivation medium and incubated for 3 days in the dark at 25°C. Co-cultivated calli were grown on 2,4-D-containing medium for 4 weeks in the dark at 28°C in the presence of a selection agent. During this period, rapidly growing resistant callus islands developed. After transfer of this material to a regeneration medium and incubation in the light, the embryogenic potential was released and shoots developed in the next four to five weeks. Shoots were excised from the calli and incubated for 2 to 3 weeks on an auxin-containing medium from which they were transferred to soil. Hardened shoots were grown under high humidity and short days in a greenhouse.

Approximately 35 independent T0 rice transformants were generated for one construct. The primary transformants were transferred from a tissue culture chamber to a greenhouse. After a quantitative PCR analysis to verify copy number of the T-DNA insert, only single copy transgenic plants that exhibit tolerance to the selection agent were kept for harvest of T1 seed. Seeds were then harvested three to five months after transplanting. The method yielded single locus transformants at a rate of over 50 % (Aldemita and Hodges1996, Chan *et al*. 1993, Hiei *et al*. 1994).

Corn transformation

Transformation of maize (*Zea mays*) is performed with a modification of the method described by Ishida et al. (1996) Nature Biotech 14(6): 745-50. Transformation is genotype-dependent in corn and only specific genotypes are amenable to transformation and regeneration. The inbred line A188 (University of Minnesota) or hybrids with A188 as a parent are good sources of donor material for transformation, but other genotypes can be used successfully as well. Ears are harvested from corn plant approximately 11 days after pollination (DAP) when the length of the immature embryo is about 1 to 1.2 mm. Immature embryos are cocultivated with *Agrobacterium tumefaciens* containing the expression vector, and transgenic plants are recovered through organogenesis. Excised embryos are grown on callus induction medium, then maize regeneration medium, containing the selection agent (for example imidazolinone but various selection markers can be used). The Petri plates are incubated in the light at 25 °C for 2-3 weeks, or until shoots develop. The green shoots are transferred from each embryo to maize rooting medium and incubated at 25 °C for 2-3 weeks, until roots develop. The rooted shoots are transplanted to soil in the greenhouse. T1 seeds are produced from plants that exhibit tolerance to the selection agent and that contain a single copy of the T-DNA insert.

Wheat transformation

Transformation of wheat is performed with the method described by Ishida et al. (1996) Nature Biotech 14(6): 745-50. The cultivar Bobwhite (available from CIMMYT, Mexico) is commonly used in transformation. Immature embryos are co-cultivated with *Agrobacterium tumefaciens* containing the expression vector, and transgenic plants are recovered through organogenesis. After incubation with *Agrobacterium*, the embryos are grown *in vitro* on callus induction medium, then regeneration medium, containing the selection agent (for example imidazolinone but various selection markers can be used). The Petri plates are incubated in the light at 25 °C for 2-3 weeks, or until shoots develop. The green shoots are transferred from each embryo to rooting medium and incubated at 25 °C for 2-3 weeks, until roots develop. The rooted shoots are transplanted to soil in the greenhouse. T1 seeds are produced from plants that exhibit tolerance to the selection agent and that contain a single copy of the T-DNA insert.

Soybean transformation

Soybean is transformed according to a modification of the method described in the Texas A&M patent US 5,164,310. Several commercial soybean varieties are amenable to transformation by this method. The cultivar Jack (available from the Illinois Seed foundation) is commonly used for transformation. Soybean seeds are sterilised for *in vitro* sowing. The hypocotyl, the radicle and one cotyledon are excised from seven-day old young seedlings. The epicotyl and the remaining cotyledon are further grown to develop axillary nodes. These axillary nodes are excised and incubated with *Agrobacterium tumefaciens* containing the expression vector. After the cocultivation treatment, the explants are washed and transferred to selection media. Regenerated shoots are excised and placed on a shoot elongation medium. Shoots no longer than 1 cm are placed on rooting medium until roots develop. The rooted shoots are transplanted to soil in the greenhouse. T1 seeds are produced from plants that exhibit tolerance to the selection agent and that contain a single copy of the T-DNA insert.

Rapeseed/canola transformation

Cotyledonary petioles and hypocotyls of 5-6 day old young seedling are used as explants for tissue culture and transformed according to Babic et al. (1998, Plant Cell Rep 17: 183-188). The commercial cultivar Westar (Agriculture Canada) is the standard variety used for transformation, but other varieties can also be used. Canola seeds are surface-sterilized for *in vitro* sowing. The cotyledon petiole explants with the cotyledon attached are excised from the *in vitro* seedlings, and inoculated with *Agrobacterium* (containing the expression vector) by dipping the cut end of the petiole explant into the bacterial suspension. The explants are then cultured for 2 days on MSBAP-3 medium containing 3 mg/l BAP, 3 % sucrose, 0.7 % Phytagar at 23 °C, 16 hr light. After two days of co-cultivation with *Agrobacterium*, the petiole explants are transferred to MSBAP-3 medium containing 3 mg/l BAP, cefotaxime, carbenicillin, or timentin (300 mg/l) for 7 days, and then cultured on MSBAP-3 medium with cefotaxime, carbenicillin, or timentin and selection agent until shoot regeneration. When the shoots are 5 – 10 mm in length, they are cut and transferred to shoot elongation medium (MSBAP-0.5, containing 0.5 mg/l BAP). Shoots of about 2 cm in length are transferred to the rooting medium (MS0) for root induction. The rooted shoots are transplanted to soil in the greenhouse. T1 seeds are produced from plants that exhibit tolerance to the selection agent and that contain a single copy of the T-DNA insert.

Alfalfa transformation

A regenerating clone of alfalfa (*Medicago sativa*) is transformed using the method of (McKersie et al., 1999 Plant Physiol 119: 839–847). Regeneration and transformation of alfalfa is

genotype dependent and therefore a regenerating plant is required. Methods to obtain regenerating plants have been described. For example, these can be selected from the cultivar Rangelander (Agriculture Canada) or any other commercial alfalfa variety as described by Brown DCW and A Atanassov (1985. Plant Cell Tissue Organ Culture 4: 111-112). Alternatively, the RA3 variety (University of Wisconsin) has been selected for use in tissue culture (Walker et al., 1978 Am J Bot 65:654-659). Petiole explants are cocultivated with an overnight culture of *Agrobacterium tumefaciens* C58C1 pMP90 (McKersie et al., 1999 Plant Physiol 119: 839–847) or LBA4404 containing the expression vector. The explants are cocultivated for 3 d in the dark on SH induction medium containing 288 mg/ L Pro, 53 mg/ L thioproline, 4.35 g/ L K2SO4, and 100 µm acetosyringinone. The explants are washed in half-strength Murashige-Skoog medium (Murashige and Skoog, 1962) and plated on the same SH induction medium without acetosyringinone but with a suitable selection agent and suitable antibiotic to inhibit *Agrobacterium* growth. After several weeks, somatic embryos are transferred to BOi2Y development medium containing no growth regulators, no antibiotics, and 50 g/ L sucrose. Somatic embryos are subsequently germinated on half-strength Murashige-Skoog medium. Rooted seedlings were transplanted into pots and grown in a greenhouse. T1 seeds are produced from plants that exhibit tolerance to the selection agent and that contain a single copy of the T-DNA insert.

Cotton transformation

Cotton is transformed using *Agrobacterium tumefaciens* according to the method described in US 5,159,135. Cotton seeds are surface sterilised in 3% sodium hypochlorite solution during 20 minutes and washed in distilled water with 500 µg/ml cefotaxime. The seeds are then transferred to SH-medium with 50µg/ml benomyl for germination. Hypocotyls of 4 to 6 days old seedlings are removed, cut into 0.5 cm pieces and are placed on 0.8% agar. An *Agrobacterium* suspension (approx. 108 cells per ml, diluted from an overnight culture transformed with the gene of interest and suitable selection markers) is used for inoculation of the hypocotyl explants. After 3 days at room temperature and lighting, the tissues are transferred to a solid medium (1.6 g/l Gelrite) with Murashige and Skoog salts with B5 vitamins (Gamborg et al., Exp. Cell Res. 50:151-158 (1968)), 0.1 mg/l 2,4-D, 0.1 mg/l 6-furfurylaminopurine and 750 µg/ml MgCL2, and with 50 to 100 µg/ml cefotaxime and 400-500 µg/ml carbenicillin to kill residual bacteria. Individual cell lines are isolated after two to three months (with subcultures every four to six weeks) and are further cultivated on selective medium for tissue amplification (30°C, 16 hr photoperiod). Transformed tissues are subsequently further cultivated on non-selective medium during 2 to 3 months to give rise to somatic embryos. Healthy looking embryos of at least 4 mm length are transferred to tubes with SH medium in fine vermiculite, supplemented with 0.1 mg/l indole acetic acid, 6

furfurylaminopurine and gibberellic acid. The embryos are cultivated at 30°C with a photoperiod of 16 hrs, and plantlets at the 2 to 3 leaf stage are transferred to pots with vermiculite and nutrients. The plants are hardened and subsequently moved to the greenhouse for further cultivation.

Example 6: Phenotypic evaluation procedure

6.1 Evaluation setup

Approximately 35 independent T0 rice transformants were generated. The primary transformants were transferred from a tissue culture chamber to a greenhouse for growing and harvest of T1 seed. Six events, of which the T1 progeny segregated 3:1 for presence/absence of the transgene, were retained. For each of these events, approximately 10 T1 seedlings containing the transgene (hetero- and homo-zygotes) and approximately 10 T1 seedlings lacking the transgene (nullizygotes) were selected by monitoring visual marker expression. The transgenic plants and the corresponding nullizygotes were grown side-by-side at random positions. Greenhouse conditions were of shorts days (12 hours light), 28°C in the light and 22°C in the dark, and a relative humidity of 70%.

Four T1 events were further evaluated in the T2 generation following the same evaluation procedure as for the T1 generation but with more individuals per event. From the stage of sowing until the stage of maturity the plants were passed several times through a digital imaging cabinet. At each time point digital images (2048x1536 pixels, 16 million colours) were taken of each plant from at least 6 different angles.

Drought screen

Plants from six events (T2 seeds) were grown in potting soil under normal conditions until they approached the heading stage. They were then transferred to a "dry" section where irrigation was withheld. Humidity probes were inserted in randomly chosen pots to monitor the soil water content (SWC). When SWC went below certain thresholds, the plants were automatically re-watered continuously until a normal level was reached again. The plants were then re-transferred again to normal conditions. The rest of the cultivation (plant maturation, seed harvest) was the same as for plants not grown under abiotic stress conditions. Growth and yield parameters are recorded as detailed for growth under normal conditions.

Nitrogen use efficiency screen

Rice plants from T2 seeds are grown in potting soil under normal conditions except for the nutrient solution. The pots are watered from transplantation to maturation with a specific nutrient solution containing reduced N nitrogen (N) content, usually between 7 to 8 times less.

The rest of the cultivation (plant maturation, seed harvest) is the same as for plants not grown under abiotic stress. Growth and yield parameters are recorded as detailed for growth under normal conditions.

Salt stress screen

Plants are grown on a substrate made of coco fibers and argex (3 to 1 ratio). A normal nutrient solution is used during the first two weeks after transplanting the plantlets in the greenhouse. After the first two weeks, 25 mM of salt (NaCl) is added to the nutrient solution, until the plants are harvested. Seed-related parameters were then measured.

6.2 Statistical analysis: F-test

A two factor ANOVA (analysis of variants) was used as a statistical model for the overall evaluation of plant phenotypic characteristics. An F-test was carried out on all the parameters measured of all the plants of all the events transformed with the gene of the present invention. The F-test was carried out to check for an effect of the gene over all the transformation events and to verify for an overall effect of the gene, also known as a global gene effect. The threshold for significance for a true global gene effect was set at a 5% probability level for the F-test. A significant F-test value points to a gene effect, meaning that it is not only the mere presence or position of the gene that is causing the differences in phenotype.

Because two experiments with overlapping events were carried out, a combined analysis was performed. This is useful to check consistency of the effects over the two experiments, and if this is the case, to accumulate evidence from both experiments in order to increase confidence in the conclusion. The method used was a mixed-model approach that takes into account the multilevel structure of the data (i.e. experiment - event - segregants). P-values were obtained by comparing likelihood ratio test to chi square distributions.

6.3 Parameters measured

Biomass-related parameter measurement

From the stage of sowing until the stage of maturity the plants were passed several times through a digital imaging cabinet. At each time point digital images (2048x1536 pixels, 16 million colours) were taken of each plant from at least 6 different angles.

The plant aboveground area (or leafy biomass) was determined by counting the total number of pixels on the digital images from aboveground plant parts discriminated from the background. This value was averaged for the pictures taken on the same time point from the different angles and was converted to a physical surface value expressed in square mm by calibration. Experiments show that the aboveground plant area measured this way correlates

with the biomass of plant parts above ground. The above ground area is the area measured at the time point at which the plant had reached its maximal leafy biomass. The early vigour is the plant (seedling) aboveground area three weeks post-germination. Increase in root biomass is expressed as an increase in total root biomass (measured as maximum biomass of roots observed during the lifespan of a plant); or as an increase in the root/shoot index (measured as the ratio between root mass and shoot mass in the period of active growth of root and shoot).

Early vigour was determined by counting the total number of pixels from aboveground plant parts discriminated from the background. This value was averaged for the pictures taken on the same time point from different angles and was converted to a physical surface value expressed in square mm by calibration. The results described below are for plants three weeks post-germination.

Seed-related parameter measurements

The mature primary panicles were harvested, counted, bagged, barcode-labelled and then dried for three days in an oven at 37°C. The panicles were then threshed and all the seeds were collected and counted. The filled husks were separated from the empty ones using an air-blowing device. The empty husks were discarded and the remaining fraction was counted again. The filled husks were weighed on an analytical balance. The number of filled seeds was determined by counting the number of filled husks that remained after the separation step. The total seed yield was measured by weighing all filled husks harvested from a plant. Total seed number per plant was measured by counting the number of husks harvested from a plant. Thousand Kernel Weight (TKW) is extrapolated from the number of filled seeds counted and their total weight. The Harvest Index (HI) in the present invention is defined as the ratio between the total seed yield and the above ground area (mm^2), multiplied by a factor 10^6. The total number of flowers per panicle as defined in the present invention is the ratio between the total number of seeds and the number of mature primary panicles. The seed fill rate as defined in the present invention is the proportion (expressed as a %) of the number of filled seeds over the total number of seeds (or florets).

Example 7: Results of the phenotypic evaluation of the transgenic plants

The results of the evaluation of transgenic rice plants expressing an HpaG nucleic acid under non-stress conditions are presented below. An increase was observed for aboveground biomass (AreaMax), emergence vigour (early vigour), total seed yield, number of filled seeds, fill rate, number of flowers per panicle, harvest index, and thousand kernel weight (see table C)

Table C: Results of the measurements for yield increase under non-stress conditions

Parameter	Overall increase (in %)	p-value of F-test
AreaMax	13	0.0000
Early vigour	25	0.0041
Total weight of seeds	30	0.0000
Nr of filled seeds	26	0.0000
Fill rate	9	0.0000
Flowers per panicle	12	0.0371
Harvest Index	18	0.0000
Thousand Kernel Weight	4	0.0000

The results of the evaluation of transgenic rice plants expressing an HpaG nucleic acid under drought-stress conditions are presented hereunder. An increase was observed for total seed weight, number of filled seeds, fill rate, harvest index and thousand-kernel weight (Table D).

Table D: Results of the measurements for yield increase under drought stress conditions

Parameter	Overall increase (in %)	p-value of F-test
Total weight of seeds	40	0.0000
Nr of filled seeds	37	0.0000
Fill rate	30	0.0000
Harvest Index	37	0.0000
Thousand Kernel Weight	3	0.0001

Example 8: Identification of sequences related to SEQ ID NO: 29 and SEQ ID NO: 30

Sequences (full length cDNA, ESTs or genomic) related to SEQ ID NO: 29 and/or protein sequences related to SEQ ID NO: 30 were identified amongst those maintained in the Entrez Nucleotides database at the National Center for Biotechnology Information (NCBI) using database sequence search tools, such as the Basic Local Alignment Tool (BLAST) (Altschul *et al.* (1990) J. Mol. Biol. 215:403-410; and Altschul *et al.* (1997) Nucleic Acids Res. 25:3389-3402). The program was used to find regions of local similarity between sequences by comparing nucleic acid or polypeptide sequences to sequence databases and by calculating the statistical significance of matches. The polypeptide encoded by SEQ ID NO: 29 was used for the TBLASTN algorithm, with default settings and the filter to ignore low complexity sequences set off. The output of the analysis was viewed by pairwise comparison, and ranked according to the probability score (E-value), where the score reflects the probability that a particular alignment occurs by chance (the lower the E-value, the more significant the hit). In addition to E-values, comparisons were also scored by percentage identity. Percentage

identity refers to the number of identical nucleotides (or amino acids) between the two compared nucleic acid (or polypeptide) sequences over a particular length. In some instances, the default parameters may be adjusted to modify the stringency of the search.

Table E provides a list of nucleic acid and polypeptide sequences related to the nucleic acid sequence as represented by SEQ ID NO: 29 and the polypeptide sequence represented by SEQ ID NO: 30.

Name	Source organism	NCBI polypeptide accession number	NA SEQ ID NO	AA SEQ ID NO
Synecho_PCC6803_SNF2	Synechocystis sp. PCC 6803 BA000022	NP_442847.1	29	30
Anava_SNF2	Anaebena variabilis ATCC 29413	YP_323780.1	31	32
Archaeon RC-I_SNF2	Uncultured methanogenic archaeon RC-I_SNF2	CAJ35100.1	33	34
Bacce_ATCC10987_SNF2	Bacillus cereus ATCC 10987	AAS44264.1	35	36
Crowa_SNF2	Crocosphaera watsonii WH 8501 ctg336	ZP_00516613.1	37	38
Glovi_SNF2	Gloeobacter violaceus PCC 7421	NP_925212	39	40
Lyn_sp_SNF2	Lyngbya sp. PCC 8106	ZP_01622333.1	41	42
Metac_C2A_SNF2	Methanosarcina acetivorans C2A	NP_615162.1	43	44
Methu_JF-1_SNF2	Methanospirillum hungatei JF-1	ABD41401.1	45	46
Metma_Go1_SNF2	Methanosarcina mazei Goe1	NP_633503.1	47	48
Mycbo_SNF2	Mycobacterium bovis BCG Pasteur 1173P2	CAL72108.1	49	50
Myctu_SNF2	Mycobacterium tuberculosis H37Rv	BX842578.1	51	52
Myxxa_DK_SNF2	Myxococcus xanthus DK 1622	YP_635387.1	53	54
Nocfa_IFM 10152_SNF2	Nocardia farcinica IFM 10152	BAD55876.1	55	56
Nodsp_SNF2	Nodularia spumigena	ZP_01629192.1	57	58
Nos_sp_PCC7120_SNF2	Nostoc sp. PCC7120	BAB78256.1	59	60
Nos_sp_PCC7120_SNF2 II	Nostoc sp. PCC 7120	ZP_00106150.1	61	62
Nospu_PCC 73102_SNF2	Nostoc punctiforme PCC 73102	NP_488438	63	64
Pelph_BU-1_SNF2	Pelodictyon phaeoclathratiforme BU-1	ZP_00589405.1	65	66
Proma_CCMP1375_SNF2	Prochlorococcus marinus str. CCMP1375	NP_874441.1	67	68
Proma_MIT 9211_SNF2	Prochlorococcus marinus str. MIT 9211	ZP_01006255.1	69	70
Proma_MIT 9303_SNF2	Prochlorococcus marinus str. MIT 9303	YP_001018833.1	71	72
Proma_MIT9313_SNF2	Prochlorococcus marinus str. MIT 9313	NP_895982.1	73	74
Rho_sp_RHA1_SNF2	Rhodococcus sp. RHA1	ABG93371.1	75	76
Saltr_CNB-440_SNF2	Salinispora tropica CNB-440	ZP_01431310	77	78

Symth_IAM14863_SNF2	Symbiobacterium thermophilum IAM 14863	BAD39642	79	80
Syn_sp_ WH 5701_SNF2	Synechococcus sp. WH 5701	ZP_01083591.1	81	82
Syn_sp_BL107_SNF2	Synechococcus sp. BL107	ZP_01469219.1	83	84
Syn_sp_CC9311_SNF2	Synechococcus sp. CC9311	YP_731958.1	85	86
Syn_sp_CC9605_SNF2	Synechococcus sp. CC9605	YP_382805.1	87	88
Syn_sp_CC9902_SNF2	Synechococcus sp. CC9902	YP_378176.1	89	90
Syn_sp_RS9916_SNF2	Synechococcus sp. RS9916	ZP_01471362	91	92
Syn_sp_WH 7805_SNF2	Synechococcus sp. WH 7805	ZP_01125039.1	93	94
Syn_sp_WH 8102_SNF2	Synechococcus sp. WH 8102	NP_898451.1	95	96
Synel_PCC6301_SNF2	Synechococcus elongatus PCC 6301	YP_171376	97	98
Synel_PCC7942_SNF2	Synechococcus elongatus PCC 7942	YP_399891.1	99	100
Theel_BP-1_SNF2	Thermosynechococcus elongatus BP-1	NP_682403.1	101	102

Additional sources of SWI2/SNF2 polypeptides useful in performing the methods of the invention can be found in the supplementary table S1C provided by Flaus *et al.* (2006). The authors scanned 24 complete archeal and 269 bacterial genomes, and identified 149 SWI2/SNF2 of the SSO1653 subfamily type.

Example 9: Alignment of SWI2/SNF2 polypeptide sequences

Alignment of polypeptide sequences was performed the Clustal algorithm (1.83) of progressive alignment, using default values (Thompson *et al.* (1997) Nucleic Acids Res 25:4876-4882; Chenna *et al.* (2003). Nucleic Acids Res 31:3497-3500). Results in Figure 8 show that SWI2/SNF2 polypeptides share sequence conservation essentially in Motifs I, Ia, II, III, IV, V, Va and VI (which are boxed), represented as follows:

(i) Motif I LADDMGLGK(T/S), as represented by SEQ ID N0: 103 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif I;

(ii) Motif Ia L(L/V/I)(V/I/L)(A/C)P(T/M/V)S(V/I/L)(V/I/L)XNW, as represented by SEQ ID N0: 104 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif Ia;

(iii) Motif II DEAQ(N/A/H)(V/I/L)KN, as represented by SEQ ID N0: 105 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif II;

(iv) Motif III A(L/M)TGTPXEN, as represented by SEQ ID N0: 106 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif III;

(v) Motif IV (L/I)XF(T/S)Q(F/Y), as represented by SEQ ID N0: 107 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif IV;

(vi) Motif V S(L/V)KAGG(V/T/L)G(L/I)(N/T)LTXA(N/S/T)HV, as represented by SEQ ID N0: 108 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif V;

(vii) Motif Va DRWWNPAVE, as represented by SEQ ID N0: 109 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif Va; and

(viii) Motif VI QA(T/S)DR(A/T/V)(F/Y)R(I/L)GQ, as represented by SEQ ID N0: 110 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif VI,

where X in Motif Ia, Motif III, Motif IV, and Motif V, is any amino acid.

These eight motifs are comprised within the ATPase domain. The ATPase domain is comprised (from N-terminus to C-terminus) between the first amino acid residue of Motif 1 and the last amino acid residue at the C-terminus of the SWI2/SNF2 polypeptide. The beginning and the end of the ATPase domain are marked in Figure 8, and the ATPase domain itself is identified using a black block above the aligned polypeptides. An example of an ATPase domain is the ATPase domain of SEQ ID NO: 30, represented by SEQ ID NO: 111.

The sequence logo of the ATPase domain of the 149 SWI2/SNF2 SSO1653 subfamily members is presented in Flaus *et al.,* (2006), and shown in Figure 6. Sequence logos are a graphical representation of an amino acid or nucleic acid multiple sequence alignment. Each logo consists of stacks of symbols, one stack for each position in the sequence. The overall height of the stack indicates the sequence conservation at that position, while the height of symbols within the stack indicates the relative frequency of each amino or nucleic acid at that position. In general, a sequence logo provides a richer and more precise description of, for example, a binding site, than would a consensus sequence. The algorithm (WebLogo) to produce such logos is available at the server of the University of California, Berkeley. The

ATPase domain as represented by SEQ ID NO: 111, and comprised in SEQ ID NO: 30, is in accordance with the sequence logo as represented in Figure 6.

An unrooted radial neighbor-joining tree of SWI2/SNF2 polypeptides from numerous SWI2/SNF2 subfamilies (including SSO1653) was constructed by Flaus *et al.,* (2006), as shown in Figure 7. The polypeptide as represented by SEQ ID NO: 30 is comprised within the SSO1653 cluster (circled in the Figure), together with all the archeal and bacterial (collectively called microbial) SWI2/SNF2 polypeptides.

Example 10: Calculation of global percentage identity between polypeptide sequences useful in performing the methods of the invention

Global percentages of similarity and identity between full length polypeptide sequences useful in performing the methods of the invention were determined using one of the methods available in the art, the MatGAT (Matrix Global Alignment Tool) software (BMC Bioinformatics. 2003 4:29. MatGAT: an application that generates similarity/identity matrices using protein or DNA sequences. Campanella JJ, Bitincka L, Smalley J; software hosted by Ledion Bitincka). MatGAT software generates similarity/identity matrices for DNA or protein sequences without needing pre-alignment of the data. The program performs a series of pair-wise alignments using the Myers and Miller global alignment algorithm (with a gap opening penalty of 12, and a gap extension penalty of 2), calculates similarity and identity using for example Blosum 62 (for polypeptides), and then places the results in a distance matrix. Sequence similarity is shown in the bottom half of the dividing line and sequence identity is shown in the top half of the diagonal dividing line.

Parameters used in the comparison were:

Scoring matrix: Blosum62

First Gap: 12

Extending gap: 2

Results of the software analysis are shown in Table F for the global similarity and identity over the full length of the polypeptide sequences (excluding the partial polypeptide sequences). Percentage identity is given above the diagonal and percentage similarity is given below the diagonal.

The percentage identity between the full length SWI2/SNF2 polypeptide sequences of the SSO1653 subfamily, useful in performing the methods of the invention, ranges between 33 and 52% amino acid identity compared to SEQ ID NO: 30 (Table F).

The percentage identity between the ATPase domain of the SWI2/SNF2 polypeptide sequences of the SSO1653 subfamily, useful in performing the methods of the invention, ranges between 45 and 70% amino acid identity compared to the ATPase domain as represented by SEQ ID NO: 111, comprised in SEQ ID NO: 30 (Table F1).

Table F: MatGAT results for global similarity and identity over the full length of the SWI2/SNF2 polypeptide sequences.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1. Synco_SNF2		**48**	**38**	**33**	**52**	**46**	**48**	**38**	**33**	**37**	**37**	**37**	**38**	**36**	**47**	**34**	**40**	**49**	**37**	**41**	**41**	**41**	**41**	**36**	**38**	**37**	**42**	**40**	**42**	**43**	**43**	**43**	**42**	**43**	**47**	**47**	**46**
2. Anava_SNF2	64		40	32	53	52	60	38	34	37	38	38	38	35	76	36	66	94	38	42	40	41	41	36	40	37	43	38	43	42	42	43	43	42	48	48	48
3. Archaeon_RC-I_SNF2	57	60		34	39	40	40	41	34	40	42	42	39	36	41	36	32	41	38	36	36	37	37	36	39	38	38	33	37	37	36	37	37	37	39	39	39
4. Bacce_ATCC10987_SNF2	49	48	52		33	34	33	33	33	32	34	34	31	34	32	32	26	32	34	30	30	28	28	33	32	35	29	27	29	30	30	30	29	29	33	33	34
5. Crowa_SNF2	68	70	60	51		47	53	36	34	36	36	36	35	32	52	35	43	53	38	41	40	38	38	33	36	34	39	34	39	38	38	38	39	39	44	44	45
6. Glovi_SNF2\	62	67	59	51	65		53	38	34	39	40	40	38	37	52	37	41	52	39	41	40	40	40	37	40	40	43	39	43	41	42	42	42	42	46	46	49
7. Lyn_sp_SNF2	64	75	60	51	71	68		37	34	37	37	37	36	33	59	35	47	60	38	41	40	39	39	34	38	37	41	36	40	41	40	41	40	40	48	48	47
8. Metac_C2A_SNF2	55	56	60	50	56	56	57		34	90	42	42	38	36	38	36	30	38	47	36	35	35	35	36	41	38	37	33	36	36	36	36	37	36	36	36	38
9. Methu_JF-1_SNF2	53	53	55	48	56	52	53	52		34	35	35	32	33	33	31	27	34	33	30	31	31	31	33	33	32	30	29	31	32	32	31	32	31	33	33	34
10. Metma_Goe1_SNF2	55	56	60	48	55	56	57	95	52		41	41	38	35	38	36	29	38	47	35	34	35	35	36	41	37	36	33	36	36	36	35	36	36	35	35	37
11. Mycbo_SNF2	53	54	58	50	56	57	53	57	52	57		99	41	43	39	35	31	38	40	35	35	35	35	41	52	39	38	33	36	36	36	37	37	37	39	39	39
12. Myctu_SNF2	53	54	58	50	56	57	53	57	52	57	99		41	42	39	35	31	38	40	35	35	35	35	41	52	39	38	33	36	36	36	37	37	37	39	39	39
13. Myxxa_DK1622_SNF2	53	55	56	46	53	54	54	55	49	56	54	54		38	39	33	30	38	37	33	33	36	36	37	43	41	37	34	36	37	36	37	37	36	37	37	37
14. Nocfa_IFM10152_SNF2	51	51	52	51	51	55	51	50	48	51	55	55	50		35	33	27	35	37	31	33	35	35	64	43	40	35	32	35	36	35	36	36	36	37	37	37
15. Nodsp_SNF2	64	87	60	49	68	67	73	56	52	56	55	55	55	50		36	68	76	37	41	41	41	41	34	39	37	41	38	42	42	41	41	42	42	46	46	48
16. Nos_sp_PCC7120_SNF2 II	53	56	58	51	56	55	55	56	51	56	54	54	52	51	55		29	37	37	33	31	30	30	32	35	32	32	29	32	32	32	32	31	31	34	34	35
17. Nospu_PCC73102_SNF2	56	75	51	47	60	60	63	47	44	46	48	48	44	47	76	48		67	30	34	34	34	34	27	30	29	33	35	34	35	34	34	35	35	36	36	39
18. Nostoc_SNF2	64	97	60	48	70	67	76	57	53	56	54	54	55	51	86	58	76		38	43	41	41	41	36	39	37	42	38	42	42	42	42	43	43	48	48	48
19. Pelph_BU-1_SNF2	55	55	57	51	56	57	56	63	52	62	58	58	53	53	54	54	48	54		35	36	37	36	37	40	39	36	35	37	38	38	37	36	38	37	37	38
20. Proma_CCMP1375_SNF2	58	60	56	47	60	58	62	56	51	55	52	52	50	48	59	52	51	59	52		63	60	60	32	34	36	58	57	61	62	61	62	61	61	41	41	40
21. Proma_MIT9211_SNF2	58	58	55	46	60	58	61	55	50	54	53	53	50	50	59	52	51	59	54	78		66	66	32	35	35	61	61	66	66	65	65	66	65	42	42	40

22. Proma_MIT9303_SNF2	58	59	54	45	59	57	59	54	50	54	51	50	52	49	58	49	50	58	51	76	80		99	35	38	37	73	75	83	82	80	84	83	82	44	44	40
23. Proma_MIT9313_SNF2	58	58	54	43	58	57	59	54	50	54	51	51	52	49	58	49	50	58	51	76	80	99		35	38	37	72	75	84	82	79	84	83	82	44	44	39
24. Rho_sp_RHA1_SNF2	51	51	51	52	52	54	51	52	49	52	55	55	49	75	50	50	48	51	54	49	51	49	49		43	40	36	31	35	35	35	35	35	35	37	37	38
25. Saltr_CNB-440_SNF2	55	56	58	49	56	56	55	58	49	57	65	65	55	56	56	54	48	55	58	52	53	52	52	55		42	39	35	39	39	39	39	39	39	40	40	39
26. Symth_IAM14863_SNF2	53	53	56	51	53	58	52	53	50	53	55	55	53	54	53	52	47	53	55	52	52	51	51	55	56		38	35	37	38	38	37	37	38	37	37	39
27. Syn_sp_WH5701_SNF2	60	59	57	46	61	60	60	54	51	54	53	53	52	50	58	50	51	60	52	73	77	81	81	51	54	53		68	74	73	73	75	75	74	47	47	42
28. Syn_sp_BL107_SNF2	56	56	53	44	57	57	57	50	47	50	49	49	48	47	55	48	53	56	51	73	75	83	83	48	50	51	79		78	85	93	78	79	85	42	42	38
29. Syn_sp_CC9311_SNF2	59	60	56	44	60	60	61	55	51	54	52	52	51	49	59	52	51	60	52	77	81	89	89	49	54	51	83	86		84	83	89	91	85	45	45	41
30. Syn_sp_CC9605_SNF2	59	60	57	46	60	59	61	55	52	55	52	52	52	50	59	52	51	60	54	78	81	88	88	51	54	53	82	90	91		90	85	85	92	45	45	41
31. Syn_sp_CC9902_SNF2	59	59	56	46	61	59	61	55	51	54	52	52	51	50	59	52	52	60	54	77	80	88	88	50	54	54	82	94	91	95		83	84	91	46	46	41
32. Syn_sp_RS9916_SNF2	59	60	56	45	59	59	60	56	50	55	53	53	52	50	58	52	51	60	53	79	81	90	90	49	55	51	83	87	94	92	92		89	85	46	46	41
33. Syn_sp_WH7805_SNF2	58	60	55	45	60	58	61	55	52	55	52	52	51	49	59	51	51	60	52	77	81	89	89	49	54	51	83	85	94	91	90	94		85	46	46	41
34. Syn_sp_WH8102_SNF2	60	60	56	45	62	59	61	54	51	55	53	53	51	50	59	51	51	60	54	78	81	89	89	51	54	53	83	91	92	96	96	92	92		46	46	41
35. Synel_PCC6301_SNF2	63	65	58	50	63	64	66	53	52	53	54	54	51	52	65	54	57	66	56	59	59	59	59	53	56	53	62	58	60	61	61	60	60	61		99	48
36. Synel_PCC7942_SNF2	63	65	58	51	63	64	66	53	52	53	54	54	51	52	65	53	57	66	56	59	59	59	59	53	56	53	62	58	60	61	61	60	60	61	99		48
37. Theel_BP-1_SNF2	60	62	56	51	63	65	63	55	51	53	55	55	51	52	61	54	55	63	54	57	55	54	54	53	54	56	58	55	56	56	57	56	56	56	64	64	

Table F1: MatGAT results for global similarity and identity between the ATPase domain of the SWI2/SNF2 polypeptide sequences.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1. ATPase_Synec_SNF2		**65**	**52**	**50**	**70**	**63**	**63**	**63**	**54**	**50**	**52**	**52**	**52**	**52**	**51**	**65**	**48**	**45**	**65**	**53**	**54**	**55**	**57**	**57**	**52**	**52**	**57**	**49**	**56**	**57**	**58**	**58**	**56**	**57**	**63**	**63**	**62**
2. ATPase_Anava_SNF2	77		55	50	70	69	69	72	54	50	53	54	54	54	52	85	51	60	97	53	55	52	55	55	54	51	56	47	56	56	55	56	56	56	65	65	67
3. ATPase_Archaeon\RC-I_SNF2	70	74		51	53	56	56	56	54	50	53	56	55	53	54	56	52	37	54	55	49	49	52	52	53	54	52	44	51	52	52	52	51	51	53	53	55
4. ATPase_Bacce_ATCC10987_SNF2	67	67	72		50	49	49	50	49	51	49	49	49	46	48	50	49	35	50	50	46	46	46	46	49	50	46	38	45	46	44	47	45	45	49	49	50
5. ATPase_Crowa_SNF2	82	84	74	68		64	64	68	52	51	52	52	52	51	50	71	51	48	70	55	56	54	56	56	51	50	55	47	55	55	55	55	56	56	63	63	63
6. ATPase_Glovi_SNF2	77	82	74	69	81		99	68	52	50	53	52	52	53	51	70	52	44	68	54	53	52	55	55	52	54	54	47	54	55	56	54	54	55	61	61	64
7. ATPase_Glovi_SNF2\	77	82	74	69	81	99		68	52	50	53	52	52	53	51	70	52	44	68	54	53	52	55	55	52	54	54	47	54	55	56	54	54	55	61	61	64
8. ATPase_Lyn_sp_SNF2	77	86	75	69	83	82	82		53	51	52	51	51	51	49	72	49	47	72	53	53	51	54	54	51	51	55	46	54	55	55	55	55	55	64	64	62
9. ATPase_Metac_C2A_SNF2	70	71	74	67	71	71	71	72		49	92	55	55	51	52	55	53	36	53	65	49	49	51	51	53	53	51	43	51	51	52	51	51	51	50	50	54
10. ATPase_Methu_JF-1_SNF2	69	70	71	69	73	70	70	70	67		48	51	51	47	48	49	49	35	50	49	43	43	45	45	50	50	43	38	43	44	44	44	44	43	50	50	52
11. ATPase_Metma_Goe1_SNF2	70	70	74	67	70	70	70	71	96	67		54	54	51	51	54	52	34	52	64	48	48	50	50	52	51	50	43	50	51	51	49	49	50	50	50	53
12. ATPase_Mycbo_SNF2	68	70	73	67	70	71	71	69	69	69	69		99	54	60	54	50	36	54	55	47	46	48	48	59	52	50	40	48	48	48	48	48	49	51	51	54
13. ATPase_Myctu_SNF2	68	70	73	67	70	71	71	69	69	69	68	99		54	60	54	49	36	54	55	47	46	48	48	59	52	50	40	48	48	48	48	48	49	51	51	54
14. ATPase_Myxxa_DK1622_SNF2	67	69	70	63	67	70	70	69	69	63	69	68	68		55	53	46	35	53	50	45	47	49	49	52	56	49	41	48	49	49	49	49	48	51	51	52
15. ATPase_Nocfa_IFM\10152_SNF2	68	69	69	65	69	70	70	66	68	65	68	73	73	67		51	49	35	52	55	46	47	49	49	75	55	49	41	49	49	48	48	49	50	50	50	52
16. ATPase_Nodsp_SNF2	77	91	76	69	85	82	82	85	71	70	71	71	71	69	70		52	58	86	53	55	53	57	57	53	52	56	47	56	57	56	56	56	56	65	65	68
17. ATPase_Nos_sp_PCC7120_SNF2\II	68	71	74	70	70	71	71	70	70	68	70	68	68	66	67	72		35	51	52	46	44	46	46	49	48	46	38	46	46	46	46	46	46	49	49	51
18. ATPase_Nospu_PCC\73102_SNF2	55	63	51	50	58	55	55	57	48	50	48	49	49	45	48	64	49		60	36	37	36	39	39	35	36	38	41	39	39	39	38	39	39	41	41	45
19. ATPase_Nostoc_SNF2	77	99	74	67	84	82	82	85	71	69	70	70	70	69	69	92	71	63		53	55	53	55	55	53	51	55	46	56	56	55	55	56	56	65	65	66
20. ATPase_Pelph_BU-1_SNF2	70	71	72	70	73	73	73	71	79	68	79	72	72	68	71	72	70	49	71		51	52	55	55	55	56	52	45	54	54	54	53	53	54	52	52	54
21. ATPase_Proma_CCMP1375_SNF2	71	71	69	66	73	72	72	71	67	64	67	66	66	64	63	73	64	49	72	68		71	71	71	48	50	69	61	70	70	70	70	71	70	57	57	56

22. ATPase_Proma_MIT\9211_SNF2	72	70	69	63	73	72	72	72	67	63	67	67	66	63	65	72	65	48	71	69	83		74	73	47	49	69	61	72	73	72	71	72	72	56	56	54
23. ATPase_Proma_MIT\9303_SNF2	74	73	70	64	75	75	75	72	69	65	69	66	66	64	65	74	64	51	72	69	84	87		99	50	53	85	75	87	88	86	87	86	88	59	59	57
24. ATPase_Proma_MIT9313_SNF2	74	73	69	64	75	75	75	72	69	65	69	66	66	64	65	74	64	51	72	69	84	87	99		50	53	85	75	87	88	86	87	86	88	59	59	57
25. ATPase_Rho_sp_RHA1_SNF2	69	71	70	66	72	70	70	69	71	67	71	74	74	67	83	73	68	50	71	73	66	65	66	66		55	50	42	50	50	50	50	50	50	52	52	52
26. ATPase_Symth_IAM14863_SNF2	67	67	71	68	67	71	71	68	70	67	68	68	68	69	69	69	68	47	67	70	65	66	68	68	69		51	44	51	53	53	52	52	52	51	51	53
27. ATPase_Syn_sp_WH5701_SNF2	74	73	69	64	75	73	73	73	68	65	68	67	67	65	65	73	64	51	73	70	83	85	93	93	66	67		73	84	84	84	85	85	86	59	59	57
28. ATPase_Syn_sp_BL107_SNF2	64	62	60	57	66	65	65	63	58	54	58	56	55	55	57	63	55	54	62	60	73	74	81	82	59	58	80		74	79	84	75	74	79	51	51	49
29. ATPase_Syn_sp_CC9311_SNF2	74	73	69	63	74	74	74	73	68	65	68	65	65	64	65	73	64	51	73	68	84	85	94	94	65	66	91	81		87	85	91	92	88	59	59	58
30. ATPase_Syn_sp_CC9605_SNF2	74	72	71	64	74	75	75	73	69	64	69	65	65	64	66	74	64	50	72	69	85	87	93	93	67	68	91	83	93		92	88	87	95	59	59	57
31. ATPase_Syn_sp_CC9902_SNF2	74	71	70	64	75	74	74	72	69	64	69	65	64	64	66	73	65	51	71	69	84	86	93	94	66	68	91	87	92	96		87	85	92	60	60	57
32. ATPase_Syn_sp_RS9916_SNF2	74	73	69	62	74	74	74	72	69	64	69	66	65	65	64	72	65	50	72	69	84	86	94	94	66	66	91	81	96	94	93		92	88	60	60	57
33. ATPase_Syn_sp_WH\7805_SNF2	72	72	68	62	73	73	73	72	68	64	68	65	65	64	63	72	64	50	72	67	83	85	92	92	65	66	91	79	95	92	91	96		88	60	60	57
34. ATPase_Syn_sp_WH\8102_SNF2	74	72	70	63	75	75	75	73	69	64	69	66	65	64	65	73	64	50	72	69	84	87	94	94	66	68	92	84	93	97	96	94	92		59	59	56
35. ATPase_Synel_PCC6301_SNF2	75	79	70	70	78	76	76	79	67	68	67	66	66	66	67	79	69	52	78	70	73	72	74	74	66	68	74	63	74	73	73	74	73	74		99	63
36. ATPase_Synel_PCC7942_SNF2	75	79	70	70	78	76	76	79	67	68	67	66	66	66	67	79	69	52	78	70	73	72	74	74	66	68	74	63	74	73	73	74	73	74	99		63
37. ATPase_Theel_BP-1_SNF2	75	78	72	69	79	79	79	76	69	71	69	68	68	66	67	79	70	54	78	71	71	70	71	71	69	69	72	63	72	71	71	72	71	71	76	76	

Example 11: Identification of domains comprised in polypeptide sequences useful in performing the methods of the invention

The Integrated Resource of Protein Families, Domains and Sites (InterPro) database is an integrated interface for the commonly used signature databases for text- and sequence-based searches. The InterPro database combines these databases, which use different methodologies and varying degrees of biological information about well-characterized proteins to derive protein signatures. Collaborating databases include SWISS-PROT, PROSITE, TrEMBL, PRINTS, ProDom and Pfam, Smart and TIGRFAMs. Interpro is hosted at the European Bioinformatics Institute in the United Kingdom.

The relevant results of the InterPro scan of the polypeptide sequence as represented by SEQ ID NO: 30 are presented in Table G. SWI2/SNF2 polypeptides (or remodeling enzymes) share sequence similarity with helicases (particularly SF2 helicases), which are enzymes capable of catalyzing the separation of DNA strands using ATP hydrolysis. The sequence similarity is limited to the ATPase domain of both types of enzymes.

Table G: InterPro scan results (major accession numbers) of the polypeptide sequence as represented by SEQ ID NO: 2.

InterPro accession number	**InterPro decription**	**Originating database**	**Original accession number**	**Accession name**
IPR000330	SNF2 related	Pfam	PF00176	SNF2_N
IPR001650	Helicase, C-terminal	Pfam	PF00271	Helicase_C
		SMART	SM00490	HELICc
		Profile	PS51194	Helicase_CTER
IPR014001	DEAD-like helicases, N-terminal	SMART	SM00487	DEXDc
IPR014021	Helicase superfamily a and 2 ATP binding	PROFILE	PS51192	Helicase_ATP_BIND_1

Example 12: Cloning of nucleic acid sequence as represented by SEQ ID NO: 29

Unless otherwise stated, recombinant DNA techniques are performed according to standard protocols described in (Sambrook (2001) Molecular Cloning: a laboratory manual, 3rd Edition Cold Spring Harbor Laboratory Press, CSH, New York) or in Volumes 1 and 2 of Ausubel et al.

(1994), Current Protocols in Molecular Biology, Current Protocols. Standard materials and methods for plant molecular work are described in Plant Molecular Biology Labfax (1993) by R.D.D. Croy, published by BIOS Scientific Publications Ltd (UK) and Blackwell Scientific Publications (UK).

The *Synechocystis* sp. PCC6803 SWI2/SNF2 gene was amplified by PCR using as template *Synechocystis* sp. PCC6803 genomic DNA. Primers prm08774 (SEQ ID NO: 113; sense,: 5'-ggggacaagtttgtacaaaaaagcaggcttaaacaatggcgactatccacggtaattgg-3') and prm08779 (SEQ ID NO: 114; reverse, complementary,: 5'- ggggaccactttgtacaagaaagctgggttcaatcggacgcttcggctt -3'), which include the AttB sites for Gateway recombination, were used for PCR amplification. PCR was performed using Hifi Taq DNA polymerase in standard conditions. A PCR fragment of the expected length (including attB sites) was amplified and purified also using standard methods. The first step of the Gateway procedure, the BP reaction, was then performed, during which the PCR fragment recombined *in vivo* with the pDONR201 plasmid to produce, according to the Gateway terminology, an "entry clone". Plasmid pDONR201 was purchased from Invitrogen, as part of the Gateway® technology.

Example 13: Expression vector construction using the nucleic acid sequence as represented by SEQ ID NO: 29

The entry clone comprising SEQ ID NO: 29 was subsequently used in an LR reaction with a destination vector used for *Oryza sativa* transformation. This vector contained as functional elements within the T-DNA borders: a plant selectable marker; a screenable marker expression cassette; and a Gateway cassette intended for LR *in vivo* recombination with the nucleic acid sequence of interest already cloned in the entry clone. A rice beta-expansin promoter (SEQ ID NO: 112) for expression in young expanding tissues was located upstream of this Gateway cassette.

After the LR recombination step, the resulting expression vector pExp::SWI2/SNF2 (Figure 8) was transformed into *Agrobacterium* strain LBA4044 according to methods well known in the art.

Example 14: Plant transformation

See Example 5 above for rice transformation

Example 15: Phenotypic evaluation procedure

15.1 Evaluation setup

Approximately 35 independent T0 rice transformants were generated. The primary transformants were transferred from a tissue culture chamber to a greenhouse for growing and harvest of T1 seed. Six events, of which the T1 progeny segregated 3:1 for presence/absence of the transgene, were retained. For each of these events, approximately 10 T1 seedlings containing the transgene (hetero- and homo-zygotes) and approximately 10 T1 seedlings lacking the transgene (nullizygotes) were selected by monitoring visual marker expression. The transgenic plants and the corresponding nullizygotes were grown side-by-side at random positions. Greenhouse conditions were of shorts days (12 hours light), 28°C in the light and 22°C in the dark, and a relative humidity of 70%.

Five T1 events were further evaluated in the T2 generation following the same evaluation procedure as for the T1 generation but with more individuals per event. From the stage of sowing until the stage of maturity the plants were passed several times through a digital imaging cabinet. At each time point digital images (2048x1536 pixels, 16 million colours) were taken of each plant from at least 6 different angles.

Drought screen

Plants from five events (T2 seeds) were grown in potting soil under normal conditions until they approached the heading stage. They were then transferred to a "dry" section where irrigation was withheld. Humidity probes were inserted in randomly chosen pots to monitor the soil water content (SWC). When SWC went below certain thresholds, the plants were automatically re-watered continuously until a normal level was reached again. The plants were then re-transferred again to normal conditions. The rest of the cultivation (plant maturation, seed harvest) was the same as for plants not grown under abiotic stress conditions. Growth and yield parameters are recorded as detailed for growth under normal conditions.

Salt stress screen

The rice plants are grown on a substrate made of coco fibers and argex (3 to 1 ratio). A normal nutrient solution is used during the first two weeks after transplanting the plantlets in the greenhouse. After the first two weeks, 25 mM of salt (NaCl) is added to the nutrient solution comprising the components listed below.

- NPK Nutrient mix, 20-20-20 Peters professional (Scotts, Marysville, OH, USA) at a concentration of 1 kg/m³.
- Magnesium chelate, Chelal Mg (BMS, Bornem, Belgium) at 333.33 ml / m³
- Iron chelate, Libfer (CIBA, Bradford, UK) at 21.67 g / m³

- NaCl 1.425 kg / m3

Salt concentration is monitored on a weekly basis and additions are made where necessary. Plants are grown under these conditions until the start of grain filling. They are then transferred to a different compartment of the greenhouse where they are irrigated daily with fresh water until seed harvest. Growth and yield parameters are recorded as for growth under normal conditions.

Reduced nutrient (nitrogen) availability screen

The rice plants are grown in potting soil under normal conditions except for the nutrient solution. The pots are watered from transplantation to maturation with a specific nutrient solution containing reduced N nitrogen (N) content, usually between 7 to 8 times less. The rest of the cultivation (plant maturation, seed harvest) is the same as for plants not grown under abiotic stress. Growth and yield parameters are recorded as for growth under normal conditions.

15.2 Statistical analysis: F-test

A two factor ANOVA (analysis of variants) was used as a statistical model for the overall evaluation of plant phenotypic characteristics. An F-test was carried out on all the parameters measured of all the plants of all the events transformed with the gene of the present invention. The F-test was carried out to check for an effect of the gene over all the transformation events and to verify for an overall effect of the gene, also known as a global gene effect. The threshold for significance for a true global gene effect was set at a 5% probability level for the F-test. A significant F-test value points to a gene effect, meaning that it is not only the mere presence or position of the gene that is causing the differences in phenotype.

15.3 Parameters measured

Biomass-related parameter measurement

From the stage of sowing until the stage of maturity the plants were passed several times through a digital imaging cabinet. At each time point digital images (2048x1536 pixels, 16 million colours) were taken of each plant from at least 6 different angles.

The plant aboveground area (or leafy biomass) was determined by counting the total number of pixels on the digital images from aboveground plant parts discriminated from the background. This value was averaged for the pictures taken on the same time point from the different angles and was converted to a physical surface value expressed in square mm by calibration. Experiments show that the aboveground plant area measured this way correlates with the biomass of plant parts above ground. The above ground area is the area measured at

the time point at which the plant had reached its maximal leafy biomass. The early vigor is the plant (seedling) aboveground area three weeks post-germination.

To measure root-related parameters, plants were grown in specially designed pots with transparent bottoms to allow visualization of the roots. A digital camera recorded images through the bottom of the pot during plant growth. Increase in root biomass is expressed as an increase in total root biomass (measured as maximum biomass of roots observed during the lifespan of a plant); or as an increase in the root/shoot index (measured as the ratio between root mass and shoot mass in the period of active growth of root and shoot). Furthermore, the maximum biomass of roots above a certain thickness threshold observed during the lifespan of a plant is calculated (thick roots), as well as maximum biomass of roots below a certain thickness threshold (thin roots).

Seed-related parameter measurements

The mature primary panicles were harvested, counted, bagged, barcode-labelled and then dried for three days in an oven at 37°C. The panicles were then threshed and all the seeds were collected and counted. The filled husks were separated from the empty ones using an air-blowing device. The empty husks were discarded and the remaining fraction was counted again. The filled husks were weighed on an analytical balance. The number of filled seeds was determined by counting the number of filled husks that remained after the separation step. The total seed weight per plant was measured by weighing all filled husks harvested from one plant. Total seed number per plant was measured by counting the number of husks harvested from a plant. Thousand Kernel Weight (TKW) is extrapolated from the number of filled seeds counted and their total weight. The Harvest Index (HI) in the present invention is defined as the ratio between the total seed weight per plant and the above ground area (mm^2), multiplied by a factor 10^6. The total number of flowers per panicle as defined in the present invention is the ratio between the total number of seeds and the number of mature primary panicles. The seed fill rate as defined in the present invention is the proportion (expressed as a %) of the number of filled seeds over the total number of seeds (or florets).

Example 16: Results of the phenotypic evaluation of the transgenic rice plants expressing the SWI2/SNF2 nucleic acid sequence, grown under normal conditions

The results of the evaluation of transgenic rice plants expressing the SWI2/SNF2 nucleic acid sequence, under normal growth conditions, are shown in Table H below.

There was an increase in the number of flowers per panicle, the total seed weight per plant, the total number of seeds, the number of filled seeds, and the harvest index of the transgenics compared to corresponding nullizygotes (controls).

Table H Results of the evaluation of transgenic rice plants expressing the SWI2/SNF2 nucleic acid sequence, under normal growth conditions.

	Average % increase of best performing events in T1 generation	**Average % increase of best performing events in T2 generation**
Number of flowers per panicle	11%	3%
Total seed weight per plant	13%	28%
Total number of seeds	14%	6%
Number of filled seeds	14%	25%
Harvest index	10%	25%

Example 17: Results of the phenotypic evaluation of the transgenic rice plants, grown under drought stress conditions

The results of the evaluation of transgenic rice plants expressing SWI2/SNF2 nucleic acid sequence, under drought stress growth conditions are presented in Table I.

There was an increase in the aboveground area, the total root biomass, the number of flowers per panicle, the seed fill rate, the total seed weight per plant, the total number of seeds, the number of filled seeds, and the harvest index of the transgenics compared to corresponding nullizygotes (controls).

Table I Results of the evaluation of transgenic rice plants expressing the SWI2/SNF2 nucleic acid sequence, under drought stress growth conditions.

	Average % increase of best performing events in T2 generation
Aboveground area	16%
Total root biomass	13%
Biomass thick roots	10%
Biomass thin roots	13%
Number of flowers per panicle	7%
Seed fill rate	28%
Total seed weight per plant	57%

Total number of seeds	44%
Number of filled seeds	54%
Harvest index	31%

Example 18: Examples of transformation of corn, alfalfa, cotton, soyabean, rapeseed/canola, wheat

See Example 5 above

5

Claims

1) A method for enhancing yield-related traits in plants relative to control plants, comprising modulating expression in a plant of a nucleic acid encoding an HpaG polypeptide comprising:

23) in increasing order of preference, at least 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95% or more sequence identity to the HpaG polypeptide sequence represented by SEQ ID NO: 2; and

24) an amino acid composition wherein the glycine content ranges between 13% and 25%, the glutamine content ranges between 13% and 20%, the cysteine content ranges between 0% and 1%, the histidine content ranges between 0% and 1%, and wherein tryptophan is absent.

2) Method according to claim 1, wherein said HpaG polypeptide further comprises one or more of the following motifs:

(i) (motif 1): G(G/E/D)(N/E)X(Q/R/P)Q(A/S)GX(N/D)G (SEQ ID NO: 3), wherein X on position 4 may be any amino acid, preferably one of S, N, P, R, or Q, and wherein X on position 9 may be any amino acid, preferably one of Q, E, S, or P; and

(ii) (motif 2): (P/A/V)S(P/Q/A)(F/L/Y)TQ(M/A)LM(H/N/Q)IV(G/M)(E/D/Q) (SEQ ID NO: 4),

3) Method according to claim 1 or 2, wherein said modulated expression is effected by introducing and expressing in a plant a nucleic acid encoding an HpaG polypeptide.

4) Method according to any preceding claim, wherein said nucleic acid encoding an Hpag polypeptide is represented by any one of the nucleic acids listed in Table A or a portion thereof, or a sequence capable of hybridising with any one of the nucleic acids given in Table A.

5) Method according to any preceding claim, wherein said nucleic acid sequence encodes an orthologue or paralogue of any of the proteins given in Table A.

6) Method according to any preceding claim, wherein said enhanced yield-related traits comprise increased yield, preferably increased biomass and/or increased seed yield relative to control plants.

7) Method according to any one of claims 1 to 6, wherein said enhanced yield-related traits are obtained under non-stress conditions.

8) Method according to any one of claims 1 to 6, wherein said enhanced yield-related traits are obtained under abiotic stress conditions.

9) Method according to any one of claims 3 to 8, wherein said nucleic acid is operably linked to a constitutive promoter, preferably to a GOS2 promoter, most preferably to a GOS2 promoter from rice.

10) Method according to any one of claims 3 to 8, wherein said nucleic acid is operably linked to a green tissue-specific promoter, preferably to a protochlorophyllide reductase promoter, most preferably to a protochlorophyllide reductase promoter from rice.

11) Method according to any preceding claim, wherein said nucleic acid encoding an HpaG polypeptide is of prokaryotic origin, preferably from a plant pathogenic bacterium possessing a Type Three Secretion System (TTSS), further preferably from the family Pseudomonaceae, more preferably from the genus *Xanthomonas,* most preferably from *Xanthomonas axonopodis.*

12) Plant or part thereof, including seeds, obtainable by a method according to any preceding claim, wherein said plant or part thereof comprises a recombinant nucleic acid encoding an HpaG polypeptide.

13) Construct comprising:

(a) nucleic acid encoding an HpaG polypeptide as defined in claims 1 or 2;

(b) one or more control sequences capable of driving expression of the nucleic acid sequence of (a); and optionally

(c) a transcription termination sequence.

14) Construct according to claim 13, wherein said one of said control sequences is selected from:

(i) a constitutive promoter, preferably a GOS2 promoter, most preferably to a GOS2 promoter from rice; or

(ii) a green tissue-specific promoter, preferably a protochlorophyllide reductase promoter, most preferably a protochlorophyllide reductase promoter from rice.

15) Use of a construct according to claim 13 or 14 in a method for making plants having increased yield, particularly increased biomass and/or increased seed yield relative to control plants.

16) Plant, plant part or plant cell transformed with a construct according to any of claims 13 or 14.

17) Method for the production of a transgenic plant having increased yield, particularly increased biomass and/or increased seed yield relative to control plants, comprising:

(i) introducing and expressing in a plant a nucleic acid encoding an HpaG polypeptide as defined in claim 1 or 2; and

(ii) cultivating the plant cell under conditions promoting plant growth and development.

18) Transgenic plant having increased yield, particularly increased biomass and/or increased seed yield, relative to control plants, resulting from increased expression of a nucleic acid encoding an HpaG polypeptide as defined in claim 1 or 2, or a transgenic plant cell derived from said transgenic plant.

19) Transgenic plant according to claim 12, 16 or 18, or a transgenic plant cell derived thereof, wherein said plant is a crop plant or a monocot or a cereal, such as rice, maize, wheat, barley, millet, rye, sorghum and oats.

20) Harvestable parts of a plant according to claim 19, wherein said harvestable parts are preferably seeds.

21) Products derived from a plant according to claim 19 and/or from harvestable parts of a plant according to claim 18.

22) Use of a nucleic acid encoding HpaG polypeptide in increasing yield, particularly in increasing seed yield, in plants relative to control plants.

23) A method for enhancing yield-related traits in plants relative to control plants, comprising increasing expression in a plant of a nucleic acid sequence encoding a SWITCH 2/ SUCROSE NON-FERMENTING 2 (SWI2/SNF2) polypeptide, which SWI2/SNF2 polypeptide comprises an ATPase domain comprising from N-terminus to C-terminus at least five, preferably six, more preferably seven, most preferably eight of the following motifs:

(i) Motif I LADDMGLGK(T/S), as represented by SEQ ID N0: 103 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif I;

(ii) Motif Ia L(L/V/I)(V/I/L)(A/C)P(T/M/V)S(V/I/L)(V/I/L)XNW, as represented by SEQ ID N0: 104 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif Ia;

(iii) Motif II DEAQ(N/A/H)(V/I/L)KN, as represented by SEQ ID N0: 105 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif II;

(iv) Motif III A(L/M)TGTPXEN, as represented by SEQ ID N0: 106 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif III;

(v) Motif IV (L/I)XF(T/S)Q(F/Y), as represented by SEQ ID N0: 107 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif IV;

(vi) Motif V S(L/V)KAGG(V/T/L)G(L/I)(N/T)LTXA(N/S/T)HV, as represented by SEQ ID N0: 108 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif V;

(vii) Motif Va DRWWNPAVE, as represented by SEQ ID N0: 109 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif Va; and

(viii) Motif VI QA(T/S)DR(A/T/V)(F/Y)R(I/L)GQ, as represented by SEQ ID N0: 110 or a motif having in increasing order of preference at least 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the sequence of Motif VI,

where X in Motif Ia, Motif III, Motif IV, and Motif V, is any amino acid.

24) Method according to claim 23, wherein said SWI2/SNF2 polypeptide, when used in the construction of a phylogenetic tree, such as the one depicted in Figure 7, tends to cluster with the SSO1653 clade of SWI2/SNF2 polypeptides comprising the polypeptide sequence as represented by SEQ ID NO: 30 rather than with any other SWI2/SNF2 clade.

25) Method according to claim 23 or 24, wherein said SWI2/SNF2 polypeptide comprises an ATPase domain having in increasing order of preference at least 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the ATPase domain as represented by SEQ ID NO: 111, comprised in SEQ ID NO: 30.

26) Method according to any one of claims 23 to 25, wherein said SWI2/SNF2 polypeptide has in increasing order of preference at least 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 98%, 99% or more sequence identity to the SWI2/SNF2 polypeptide as represented by SEQ ID NO: 30 or to any of the polypeptide sequences given in Table E herein.

27) Method according to any one of claims 23 to 26, wherein said nucleic acid sequence encoding a SWI2/SNF2 polypeptide is represented by any one of the nucleic acid sequence SEQ ID NOs given in Table E or a portion thereof, or a sequence capable of hybridising with any one of the nucleic acid sequences SEQ ID NOs given in Table E.

28) Method according to any one of claims 23 to 27, wherein said nucleic acid sequence encodes an orthologue or paralogue of any of the SEQ ID NOs given in Table E.

29) Method according to any one of claims 23 to 28, wherein said increased expression is effected by introducing and expressing in a plant a nucleic acid sequence encoding a SWI2/SNF2 polypeptide.

30) Method according to any one of claims 23 to 29, wherein said yield-related traits are one or more of: (i) increased number of flowers per panicle; (ii) increased total seed weight per plant; (iii) increased number of (filled) seeds; or (iv) increased harvest index.

31) Method according to any one of claims 23 to 30, wherein said yield-related traits are enhanced in plants grown under abiotic stress conditions, preferably under water stress conditions, most preferably under drought stress conditions, relative to control plants grown under comparable stress conditions.

32) Method according to claim 31, wherein said enhanced yield-related traits are one or more of: (i) increased aboveground area; (ii) increased total root biomass; (iii) increased thick root biomass; (iv) increased thin root biomass; (v) increased number of flowers per panicle; (vi) increased seed fill rate; (vii) increased total seed weight per plant; (viii) increased number of (filled) seeds; or (ix) increased harvest index.

33) Method according to any one of claims 23 to 32, wherein said nucleic acid sequence is operably linked to a tissue-specific promoter, preferably to a promoter capable of preferentially expressing the nucleic acid sequence in young expanding tissues, most preferably to a beta-expansin promoter.

34) Method according to any one of claims 23 to 33, wherein said nucleic acid sequence encoding a SWI2/SNF2 polypeptide is from a microbial genome, further preferably from archea or bacteria, more preferably from cyanobacteria, such as Synechocystis sp., Nostoc sp., Synechococcus sp., Prochlorococcus sp., Anaebena sp., Gloeobacter sp., or Thermosynechococcus sp., more preferably from Synechocystis sp., most preferably from Synechocystis sp. PCC6803.

35) Plants, parts thereof (including seeds), or plant cells obtainable by a method according to any one of claims 23 to 34, wherein said plant, part or cell thereof comprises an isolated nucleic acid transgene encoding a SWI2/SNF2 polypeptide.

36) Construct comprising:

(a) A nucleic acid sequence encoding a SWI2/SNF2 polypeptide as defined in any one of claims 23 to 28;

(b) one or more control sequences capable of driving expression of the nucleic acid sequence of (a); and optionally

(c) a transcription termination sequence.

37) Construct according to claim 36, wherein said one of said control sequences is a tissue-specific promoter, preferably a promoter for expression in young expanding tissues, most preferably a beta-expansin promoter.

38) Use of a construct according to claims 36 or 37 in a method for making plants having enhanced yield-related traits relative to control plants.

39) Plant, plant part or plant cell transformed with a construct according to claim 36 or 37.

40) Method for the production of transgenic plants having enhanced yield-related traits relative to control plants, comprising:

(i) introducing and expressing in a plant a nucleic acid sequence encoding a SWI2/SNF2 polypeptide as defined in any one of claims 23 to 28; and

(ii) cultivating the plant cell under conditions promoting plant growth and development.

41) Transgenic plant having enhanced yield-related traits relative to control plants, resulting from increased expression of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide as defined in any one of claims 23 to 28, or a transgenic plant cell derived from said transgenic plant.

42) Transgenic plant according to claim 35, 39 or 41, wherein said plant is a crop plant or a monocot or a cereal, such as rice, maize, wheat, barley, millet, rye, triticale, sorghum and oats, or a transgenic plant cell derived from said transgenic plant.

43) Harvestable parts of a plant according to claim 42, wherein said harvestable parts are preferably seeds.

44) Products derived from a plant according to claim 42 and/or from harvestable parts of a plant according to claim 43.

45) Use of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide as defined in any one of claims 23 to 28 in enhancing yield-related traits in plants, preferably in increasing one or more of: (i) increased number of flowers per panicle; (ii) increased total seed weight per plant; (iii) increased number of (filled) seeds; or (iv) increased harvest index.

46) Use of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide as defined in any one of claims 23 to 28 in enhancing yield-related traits in plants, wherein said yield-related traits are enhanced in plants grown under abiotic stress conditions, preferably under water stress conditions, most preferably under drought stress conditions, relative to control plants grown under comparable stress conditions.

47) Use of a nucleic acid sequence according to claim 45, wherein said enhanced yield-related traits are one or more of: (i) increased aboveground area; (ii) increased total root biomass; (iii) increased thick root biomass; (iv) increased thin root biomass; (v) increased number of flowers per panicle; (vi) increased seed fill rate; (vii) increased total seed weight per plant; (viii) increased number of (filled) seeds; or (ix) increased harvest index.

FIGURE 1

```
CLUSTAL W (1.83) multiple sequence alignment

ABJ97680          MNSLNTQFGGSTSNLQVGPSQ--DTTFGSNQG--GNQGISEKQLDQLLCQLISALLQSSK
AAC95121          MNSLNTQFGGSTSNLQVGPSQ--DTTFGSNQG--GNQGISEKQLDQLLCQLISALLQSSK
BAD29979          MNSLNTQFGGSTSNLQVGPSQ--DTTFGSNQG--GNQGISEKQLDQLLCQLISALLQSSK
ABB72197          MNSLNTQFGGSASNFQVDQSQ--NAQSDSSQGSNGSQGISEKQLDQLLCQLIQALLQPNK
SEQID2_           MNSLNTQLGANSSFFQVDPGQ--NTQSS---PNQGNQGISEKQLDQLLTQLIMALLQQSN
ABK51590          MNSLNTQLGANSSFFQVDPGQ--NTQSS---PNQGN-----------TQLIMALLQQSN
ABK51589          MNSLNTQLGANSSFFQVDPGQ--NTQSS---PNQGNQGISEKQLDQLLCQLIMALLQQSN
ABK51587          MNSLNTQLGANSSFFQVDPGQ--NTQSS---PNQGNQGISEKQLDQLLTQLIMALLQQSN
ABK51588          MNSLNTQLGANSSFFQVDPGQ--NTQSS---PNQGNQGISEKQLDQLLTQLIMALLQQSN
AAM35307          MNSLNTQLGANSSFFQVDPSQ--NTQSG---SNQGNQGISEKQLDQLLTQLIMALLQQSN
ABG36696          MNSLNTQIGANSSFLQVDPSQ--NTQFG---PNQGNQGISEKQLDQLLTQLIMALLQQSN
AAM40538          ---MDSSIGNKFSNFINLQTMGIGPQQTQNSSQRSPSADSEQQLDQLLAMFIMMMLQQSQ
                     ::::.:* . * :        ..         .                :*  :** .:
```

FIGURE 1 (continued)

```
ABJ97680        NAEEGKG-QGGDNGGGQGGNSQQAGQQNG-PSPFTQMLMHIVGEILQAQNGGGAGGGGFG
AAC95121        NAEEGKG-QGGDNGGGQGGNSQQAGQQNG-PSPFTQMLMHIVGEILQAQNGGGAGGGGFG
BAD29979        NAEEGKG-QGGDNGGGQGGNSQQAGQQNG-PSPFTQMLMHIVGEILQAQNGGGAGGGGFG
ABB72197        NAEEGKG-QQG------GENNQQAGKENG-ASPLTQMLMNIVGEILQAQNAGGSSGGDFG
SEQID2_         NAEQGQGQGQGGDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQNGGGFGGGFGG
ABK51590        NAEQGQGQGQGGDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQNGGGFGGGFGG
ABK51589        NAEQGQGQGQGGDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQNGGGFGGGFGG
ABK51587        NAEQGQGQGQGGDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGD--------GFGGGFGG
ABK51588        NAEQGQGQGQGGDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQN----------
AAM35307        NAEQGQGQGQGGDSGGQGGNRQQAGQSNGSPSQYTQMLMNIVGDILQAQNGGGFGGGFGG
ABG36696        NADQ----GQGGDSGGQGGNSRQAGQPNGSPSAYTQMLMNIVGDILQAQNGGGFGGGFGG
AAM40538        GSDADQE---------CGDEQPQSGQQDG-VSPLTQMLMQIVMQLMQNQGGAGMGGTSLG
                .::               * :  *:*: :*  *  ** **:**
```

```
ABJ97680  GGFGGDFS---------GDLGLGTNLSSDSASMQ
AAC95121  GGFGGDFS---------GDLGLGTNLSSDSASMQ
BAD29979  GGFGGDFS---------GDLGLGTNLSSDSASMQ
ABB72197  GSFASSFS---------NDSGSMQ----------
SEQID2_   GFGGILVT---SLASDTGSMQ----------
ABK51590  GFGGILVT---SLASDTGSMQ----------
ABK51589  GFGGILVT---SLASDTGSMQ----------
ABK51587  GFGGILVT---SLASDTGSMQ----------
ABK51588  --GFILVT---SLASDTGSMQ----------
AAM35307  GFGGGLGTSLGTSLASDTGSMQ----------
ABG36696  GFGGGLGTSLGSSLASDTGSMQ----------
AAM40538  GGFNANLS---------SITGQA----------
                                 *
                                 .
                                 :
```

FIGURE 1 (continued)

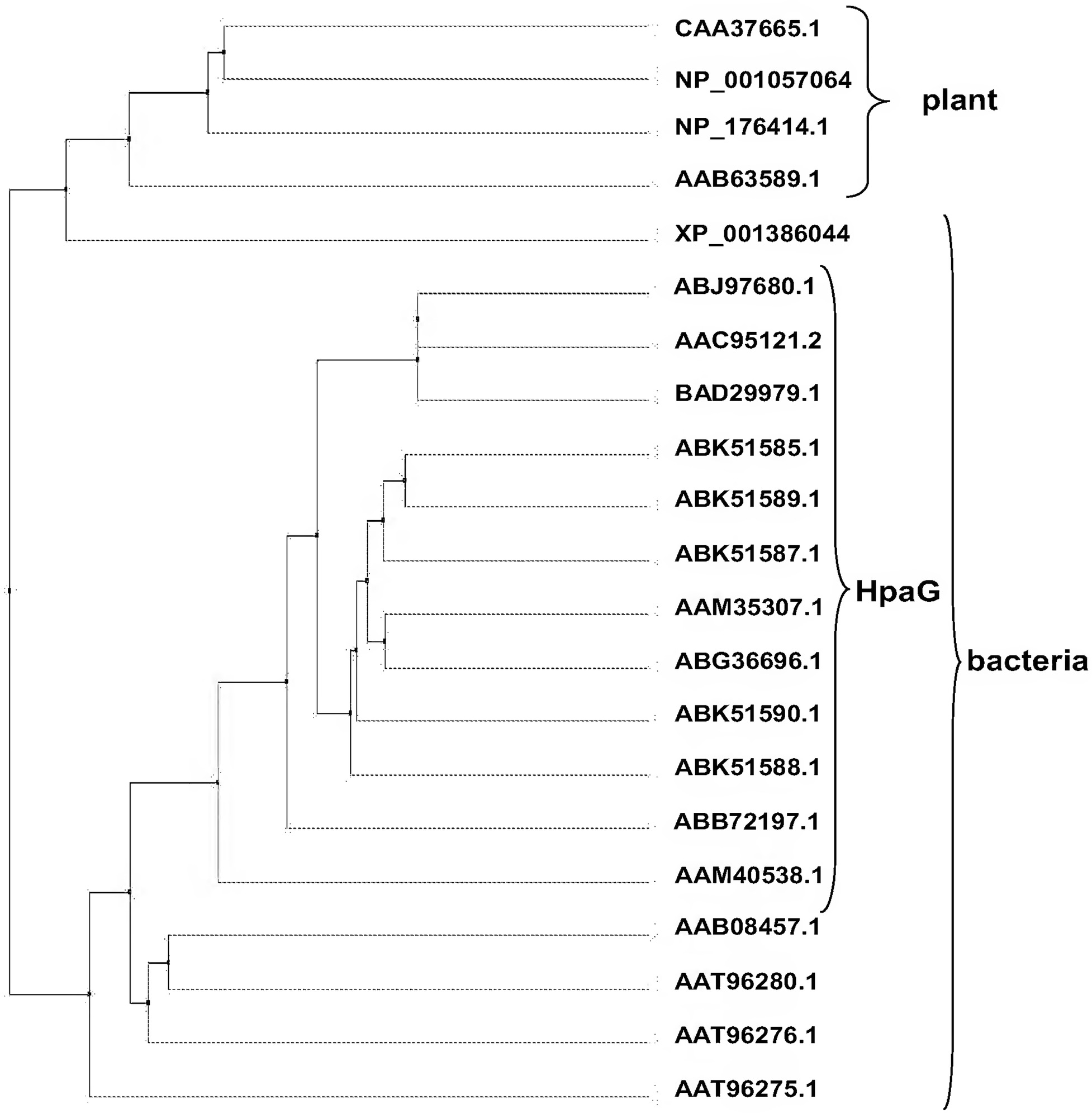
CAA37665.1
NP_001057064
NP_176414.1
AAB63589.1
plant
XP_001386044
ABJ97680.1
AAC95121.2
BAD29979.1
ABK51585.1
ABK51589.1
ABK51587.1
AAM35307.1
ABG36696.1
ABK51590.1
ABK51588.1
ABB72197.1
AAM40538.1
HpaG
AAB08457.1
AAT96280.1
AAT96276.1
AAT96275.1
bacteria

FIGURE 2

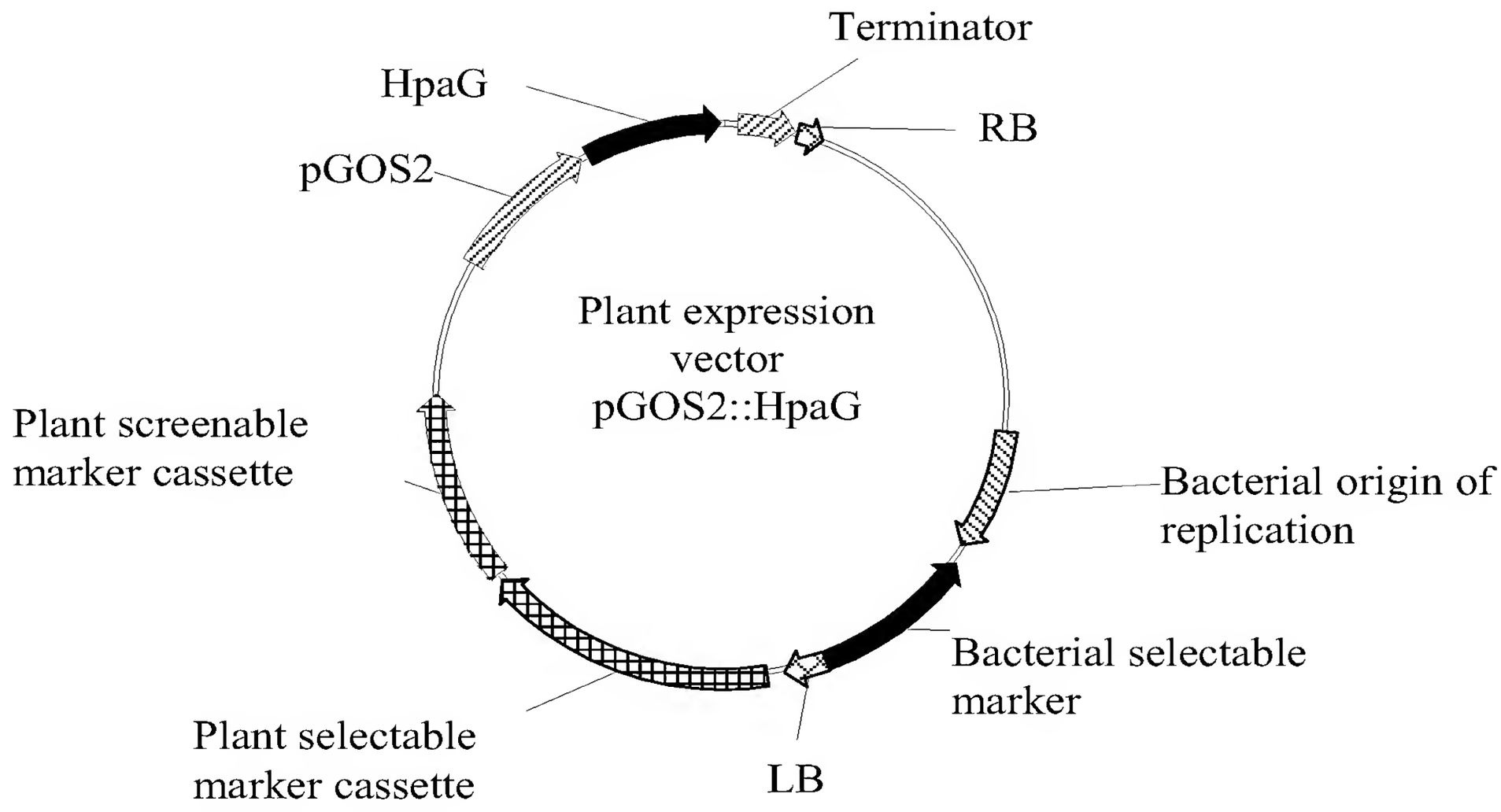
Terminator
HpaG
RB
pGOS2
Plant expression vector pGOS2::HpaG
Plant screenable marker cassette
Bacterial origin of replication
Bacterial selectable marker
Plant selectable marker cassette
LB

FIGURE 3

SEQ ID NO: 1, EF050509.1, Xanthomonas axonopodis elicitor of hypersensitive response HpaG (hpaG) gene, complete cds

ATGAATTCTTTGAACACACAGCTCGGCGCCAACTCGTCCTTCTTTCAGGTTGACCCCGGCCAGAAC
ACGCAATCTAGTCCGAACCAGGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGCTGCTGACC
CAGCTCATCATGGCCCTGCTTCAGCAGAGCAACAATGCCGAGCAGGGTCAGGGTCAAGGCCAGGGT
GGTGACTCTGGCGGTCAGGGCGGCAATCCGCGGCAGGCCGGGCAGTCCAACGGCTCCCCCTCGCAA
TACACCCAGGCGCTGATGAATATCGTCGGAGACATTCTCCAGGCGCAGAATGGTGGCGGCTTCGGC
GGCGGCTTTGGTGGTGGCTTCGGTGGCATCCTCGTCACCAGCCTTGCGAGCGACACCGGATCGATG
CAGTAA

SEQ ID NO: 2, ABK51582.1, elicitor of hypersensitive response HpaG [Xanthomonas axonopodis]

MNSLNTQLGANSSFFQVDPGQNTQSSPNQGNQGISEKQLDQLLTQLIMALLQQSNNAEQGQGQGQG
GDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQNGGGFGGGFGGGFGGILVTSLASDTGSM
Q

SEQ ID NO: 3, conserved motif 1

G(G/E/D)(N/E)X(Q/R/P)Q(A/S)GX(N/D)G

SEQ ID NO: 4, conserved motif 2

(P/A/V)S(P/Q/A)(F/L/Y)TQ(M/A)LM(H/N/Q)IV(G/M)(E/D/Q)

SEQ ID NO: 5, constitutive promoter GOS2

AATCCGAAAAGTTTCTGCACCGTTTTCACCCCCTAACTAACAATATAGGGAACGTGTGCTAAATAT
AAAATGAGACCTTATATATGTAGCGCTGATAACTAGAACTATGCAAGAAAAACTCATCCACCTACT
TTAGTGGCAATCGGGCTAAATAAAAAAGAGTCGCTACACTAGTTTCGTTTTCCTTAGTAATTAAGT
GGGAAAATGAAATCATTATTGCTTAGAATATACGTTCACATCTCTGTCATGAAGTTAAATTATTCG
AGGTAGCCATAATTGTCATCAAACTCTTCTTGAATAAAAAAATCTTTCTAGCTGAACTCAATGGGT
AAAGAGAGAGATTTTTTTTAAAAAAATAGAATGAAGATATTCTGAACGTATTGGCAAAGATTTAAA
CATATAATTATATAATTTTATAGTTTGTGCATTCGTCATATCGCACATCATTAAGGACATGTCTTA
CTCCATCCCAATTTTTATTTAGTAATTAAAGACAATTGACTTATTTTTATTATTTATCTTTTTTCG
ATTAGATGCAAGGTACTTACGCACACACTTTGTGCTCATGTGCATGTGTGAGTGCACCTCCTCAAT
ACACGTTCAACTAGCAACACATCTCTAATATCACTCGCCTATTTAATACATTTAGGTAGCAATATC
TGAATTCAAGCACTCCACCATCACCAGACCACTTTTAATAATATCTAAAATACAAAAAATAATTTT
ACAGAATAGCATGAAAAGTATGAAACGAACTATTTAGGTTTTTCACATACAAAAAAAAAAAGAATT
TTGCTCGTGCGCGAGCGCCAATCTCCCATATTGGGCACACAGGCAACAACAGAGTGGCTGCCCACA
GAACAACCCACAAAAAACGATGATCTAACGGAGGACAGCAAGTCCGCAACAACCTTTTAACAGCAG
GCTTTGCGGCCAGGAGAGAGGAGGAGAGGCAAAGAAAACCAAGCATCCTCCTTCTCCCATCTATAA
ATTCCTCCCCCCCTTTTCCCCTCTCTATATAGGAGGCATCCAAGCCAAGAAGAGGGAGAGCACCAAG
GACACGCGACTAGCAGAAGCCGAGCGACCGCCTTCTCGATCCATATCTTCCGGTCGAGTTCTTGGT
CGATCTCTTCCCTCCTCCACCTCCTCCTCACAGGGTATGTGCCTCCCTTCGGTTGTTCTTGGATTT
ATTGTTCTAGGTTGTGTAGTACGGGCGTTGATGTTAGGAAAGGGGATCTGTATCTGTGATGATTCC
TGTTCTTGGATTTGGGATAGAGGGGTTCTTGATGTTGCATGTTATCGGTTCGGTTTGATTAGTAGT
ATGGTTTTCAATCGTCTGGAGAGCTCTATGGAAATGAAATGGTTTAGGGATCGGAATCTTGCGATT
TTGTGAGTACCTTTTGTTTGAGGTAAAATCAGAGCACCGGTGATTTTGCTTGGTGTAATAAAGTAC
GGTTGTTTGGTCCTCGATTCTGGTAGTGATGCTTCTCGATTTGACGAAGCTATCCTTTGTTTATTC
CCTATTGAACAAAAATAATCCAACTTTGAAGACGGTCCCGTTGATGAGATTGAATGATTGATTCTT
AAGCCTGTCCAAAATTTCGCAGCTGGCTTGTTTAGATACAGTAGTCCCCATCACGAAATTCATGGA

FIGURE 4

AACAGTTATAATCCTCAGGAACAGGGGATTCCCTGTTCTTCCGATTTGCTTTAGTCCCAGAATTTT
TTTTCCCAAATATCTTAAAAAGTCACTTTCTGGTTCAGTTCAATGAATTGATTGCTACAAATAATG
CTTTTATAGCGTTATCCTAGCTGTAGTTCAGTTAATAGGTAATACCCCTATAGTTTAGTCAGGAGA
AGAACTTATCCGATTTCTGATCTCCATTTTTAATTATATGAAATGAACTGTAGCATAAGCAGTATT
CATTTGGATTATTTTTTTTATTAGCTCTCACCCCTTCATTATTCTGAGCTGAAAGTCTGGCATGAA
CTGTCCTCAATTTTGTTTTCAAATTCACATCGATTATCTATGCATTATCCTCTTGTATCTACCTGT
AGAAGTTTCTTTTTGGTTATTCCTTGACTGCTTGATTACAGAAAGAAATTTATGAAGCTGTAATCG
GGATAGTTATACTGCTTGTTCTTATGATTCATTTCCTTTGTGCAGTTCTTGGTGTAGCTTGCCACT
TTCACCAGCAAAGTTC

SEQ ID NO: 6, green tissue specific promoter PCR

TTGCAGTTGTGACCAAGTAAGCTGAGCATGCCCTTAACTTCACCTAGAAAAAAGTATACTTGGCTT
AACTGCTAGTAAGACATTTCAGAACTGAGACTGGTGTACGCATTTCATGCAAGCCATTACCACTTT
ACCTGACATTTTGGACAGAGATTAGAAATAGTTTCGTACTACCTGCAAGTTGCAACTTGAAAAGTG
AAATTTGTTCCTTGCTAATATATTGGCGTGTAATTCTTTTATGCGTTAGCGTAAAAAGTTGAAATT
TGGGTCAAGTTACTGGTCAGATTAACCAGTAACTGGTTAAAGTTGAAAGATGGTCTTTTAGTAATG
GAGGGAGTACTACACTATCCTCAGCTGATTTAAATCTTATTCCGTCGGTGGTGATTTCGTCAATCT
CCCAACTTAGTTTTTCAATATATTCATAGGATAGAGTGTGCATATGTGTGTTTATAGGGATGAGTC
TACGCGCCTTATGAACACCTACTTTTGTACTGTATTTGTCAATGAAAAGAAAATCTTACCAATGCT
GCGATGCTGACACCAAGAAGAGGCGATGAAAAGTGCAACGGATATCGTGCCACGTCGGTTGCCAAG
TCAGCACAGACCCAATGGGCCTTTCCTACGTGTCTCGGCCACAGCCAGTCGTTTACCGCACGTTCA
CATGGGCACGAACTCGCGTCATCTTCCCACGCAAAACGACAGATCTGCCCTATCTGGTCCCACCCA
TCAGTGGCCCACACCTCCCATGCTGCATTATTTGCGACTCCCATCCCGTCCTCCACGCCCAAACAC
CGCACACGGGTCGCGATAGCCACGACCCAATCACACAACGCCACGTCACCATATGTTACGGGCAGC
CATGCGCAGAAGATCCCGCGACGTCGCTGTCCCCCGTGTCGGTTACGAAAAAATATCCCACCACGT
GTCGCTTTCACAGGACAATATCTCGAAGGAAAAAAATCGTAGCGGAAAATCCGAGGCACGAGCTGC
GATTGGCTGGGAGGCGTCCAGCGTGGTGGGGGGCCCACCCCCTTATCCTTAGCCCGTGGCGCTCCT
CGCTCCTCGGGTCCGTGTATAAATACCCTCCGGAACTCACTCTTGCTGGTCACCAACACGAAGCAA
AAGGACACCAGAAACATAGTACACTTGAGCTCACTCCAAACTCAAACACTCACACCA

SEQ ID NO: 7, EF042294, Synthetic construct mutant elicitor of hypersensitive response HpaG_T44C gene, complete cds

ATGAATTCTTTGAACACACAGCTCGGCGCCAACTCGTCCTTCTTTCAGGTTGACCCCGGCCAGAAC
ACGCAATCTAGTCCGAACCAGGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGCTGCTGTGC
CAGCTCATCATGGCCCTGCTTCAGCAGAGCAACAATGCCGAGCAGGGTCAGGGTCAAGGCCAGGGT
GGTGACTCTGGCGGTCAGGGCGGCAATCCGCGGCAGGCCGGGCAGTCCAACGGCTCCCCCTCGCAA
TACACCCAGGCGCTGATGAATATCGTCGGAGACATTCTCCAGGCGCAGAATGGTGGCGGCTTCGGC
GGCGGCTTTGGTGGTGGCTTCGGTGGCATCCTCGTCACCAGCCTTGCGAGCGACACCGGATCGATG
CAGTAA

SEQ ID NO: 8, ABK51589, mutant elicitor of hypersensitive response HpaG_T44C [synthetic construct]

MNSLNTQLGANSSFFQVDPGQNTQSSPNQGNQGISEKQLDQLLCQLIMALLQQSNNAEQGQGQGQG
GDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQNGGGFGGGFGGGFGGILVTSLASDTGSM
Q

FIGURE 4 (continued)

SEQ ID NO: 9, EF042292, Synthetic construct mutant elicitor of hypersensitive response HpaG-T gene, complete cds

ATGAATTCTTTGAACACACAGCTCGGCGCCAACTCGTCCTTCTTTCAGGTTGACCCCGGCCAGAAC
ACGCAATCTAGTCCGAACCAGGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGCTGCTGACC
CAGCTCATCATGGCCCTGCTTCAGCAGAGCAACAATGCCGAGCAGGGTCAGGGTCAAGGCCAGGGT
GGTGACTCTGGCGGTCAGGGCGGCAATCCGCGGCAGGCCGGGCAGTCCAACGGCTCCCCCTCGCAA
TACACCCAGGCGCTGATGAATATCGTCGGAGACGGCTTCGGCGGCGGCTTTGGTGGTGGCTTCGGT
GGCATCCTCGTCACCAGCCTTGCGAGCGACACCGGATCGATGCAGTAA

SEQ ID NO: 10, ABK51587, mutant elicitor of hypersensitive response HpaG-T [synthetic construct]

MNSLNTQLGANSSFFQVDPGQNTQSSPNQGNQGISEKQLDQLLTQLIMALLQQSNNAEQGQGQGQG
GDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDGFGGGFGGGFGGILVTSLASDTGSMQ

SEQ ID NO: 11, 21106495:2613-3026 Xanthomonas axonopodis pv. citri str. 306, section 45 of 469 of the complete genome

TTACTGCATCGATCCGGTGTCGCTCGCAAGGCTGGTGCCGAGGCTGGTGCCGAGGCCGCCGCCGAA
GCCACCACCAAAGCCGCCGCCGAAGCCACCACCATTCTGCGCCTGGAGAATGTCTCCGACGATATT
CATCAGCATCTGGGTGTATTGCGAGGGGGAGCCGTTGGACTGACCGGCCTGCTGCCGATTGCCGCC
CTGACCACCAGAGTCACCACCCTGGCCTTGACCCTGACCCTGCTCGGCATTGTTGCTCTGCTGAAG
CAGGGCCATGATGAGCTGGGTCAGCAGCTGGTCCAGTTGCTTTTCCGAGATGCCCTGGTTGCCCTG
GTTCGAACCAGATTGCGTGTTCTGGCTGGGGTCAACCTGAAAGAAGGACGAGTTGGCGCCGAGCTG
TGTGTTCAAAGAATTCAT

SEQ ID NO: 12, AAM35307, Hpa1 protein [Xanthomonas axonopodis pv. citri str. 306]

MNSLNTQLGANSSFFQVDPSQNTQSGSNQGNQGISEKQLDQLLTQLIMALLQQSNNAEQGQGQGQG
GDSGGQGGNRQQAGQSNGSPSQYTQMLMNIVGDILQAQNGGGFGGGFGGGFGGGLGTSLGTSLASD
TGSMQ

SEQ ID NO: 13, EF042295, Synthetic construct mutant elicitor of hypersensitive response HpaG-N gene, complete cds

ATGAATTCTTTGAACACACAGCTCGGCGCCAACTCGTCCTTCTTTCAGGTTGACCCCGGCCAGAAC
ACGCAATCTAGTCCGAACCAGGGCAACACCCAGCTCATCATGGCCCTGCTTCAGCAGAGCAACAAT
GCCGAGCAGGGTCAGGGTCAAGGCCAGGGTGGTGACTCTGGCGGTCAGGGCGGCAATCCGCGGCAG
GCCGGGCAGTCCAACGGCTCCCCCTCGCAATACACCCAGGCGCTGATGAATATCGTCGGAGACATT
CTCCAGGCGCAGAATGGTGGCGGCTTCGGCGGCGGCTTTGGTGGTGGCTTCGGTGGCATCCTCGTC
ACCAGCCTTGCGAGCGACACCGGATCGATGCAGTAA

SEQ ID NO: 14, ABK51590, mutant elicitor of hypersensitive response HpaG-N [synthetic construct]

MNSLNTQLGANSSFFQVDPGQNTQSSPNQGNTQLIMALLQQSNNAEQGQGQGQGGDSGGQGGNPRQ
AGQSNGSPSQYTQALMNIVGDILQAQNGGGFGGGFGGGFGGILVTSLASDTGSMQ

SEQ ID NO: 15, EF042293, Xanthomonas axonopodis HpaG_G gene, complete cds

ATGAATTCTTTGAACACACAGCTCGGCGCCAACTCGTCCTTCTTTCAGGTTGACCCCGGCCAGAAC
ACGCAATCTAGTCCGAACCAGGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGCTGCTGACC

FIGURE 4 (continued)

CAGCTCATCATGGCCCTGCTTCAGCAGAGCAACAATGCCGAGCAGGGTCAGGGTCAAGGCCAGGGT
GGTGACTCTGGCGGTCAGGGCGGCAATCCGCGGCAGGCCGGGCAGTCCAACGGCTCCCCCTCGCAA
TACACCCAGGCGCTGATGAATATCGTCGGAGACATTCTCCAGGCGCAGAATGGCTTTATCCTCGTC
ACCAGCCTTGCGAGCGACACCGGATCGATGCAGTAA

SEQ ID NO: 16, ABK51588, HpaG_G [Xanthomonas axonopodis]
MNSLNTQLGANSSFFQVDPGQNTQSSPNQGNQGISEKQLDQLLTQLIMALLQQSNNAEQGQGQGQG
GDSGGQGGNPRQAGQSNGSPSQYTQALMNIVGDILQAQNGFILVTSLASDTGSMQ

SEQ ID NO: 17, DQ643828, Xanthomonas smithii subsp. smithii Hrp gene, complete cds
ATGAATTCTTTGAACACACAGATCGGCGCCAACTCGTCCTTCTTGCAGGTCGACCCGAGCCAGAAC
ACGCAATTCGGTCCGAACCAGGGCAATCAAGGCATCTCGGAAAAGCAGCTGGACCAGCTGCTGACC
CAGCTCATCATGGCCCTGCTTCAGCAGAGCAACAATGCCGACCAGGGTCAGGGTGGTGACTCTGGT
GGTCAAGGCGGCAATTCGCGGCAGGCCGGGCAGCCCAATGGTTCCCCCTCGGCATACACCCAGATG
CTGATGAATATCGTCGGAGACATTCTCCAGGCGCAGAATGGTGGTGGCTTCGGCGGCGGGTTCGGC
GGTGGCTTTGGTGGCGGGCTCGGCACCAGCCTCGGCAGCAGCCTTGCGAGCGACACCGGATCGATG
CAGTAA

SEQ ID NO: 18, ABG36696, Hrp [Xanthomonas smithii subsp. smithii]
MNSLNTQIGANSSFLQVDPSQNTQFGPNQGNQGISEKQLDQLLTQLIMALLQQSNNADQGQGGDSG
GQGGNSRQAGQPNGSPSAYTQMLMNIVGDILQAQNGGGFGGGFGGGFGGGLGTSLGSSLASDTGSM
Q

SEQ ID NO: 19, gi|116292746:1016-1435 Xanthomonas oryzae pv. oryzae strain JXOIII hrp gene cluster, partial sequence
ATGAACTCTTTGAACACACAATTCGGCGGCAGCACGTCCAACCTTCAGGTTGGCCCAAGCCAGGAC
ACAACGTTCGGTTCGAACCAGGGCGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGTTGCTG
TGCCAGCTCATCTCGGCCCTGCTTCAGTCGAGCAAAAATGCTGAGGAGGGTAAGGGTCAGGGTGGC
GATAATGGCGGTGGCCAGGGCGGCAATTCGCAGCAGGCCGGGCAGCAGAATGGCCCCTCGCCATTC
ACCCAGATGCTGATGCATATCGTCGGAGAGATTCTCCAGGCGCAGAATGGTGGTGGTGCTGGTGGC
GGCGGTTTCGGCGGCGGGTTCGGCGGCGACTTTAGTGGCGACCTCGGCCTCGGCACCAACCTCTCG
AGCGACAGCGCATCAATGCAGTAA

SEQ ID NO: 20, ABJ97680, hypersensitive response-functioning factor A [Xanthomonas oryzae pv. oryzae]
MNSLNTQFGGSTSNLQVGPSQDTTFGSNQGGNQGISEKQLDQLLCQLISALLQSSKNAEEGKGQGG
DNGGGQGGNSQQAGQQNGPSPFTQMLMHIVGEILQAQNGGGAGGGGFGGGFGGDFSGDLGLGTNLS
SDSASMQ

SEQ ID NO: 21, gi|42717988:1136-1555 Xanthomonas oryzae pv. oryzae hrp gene cluster, partial sequence
ATGAATTCTTTGAACACACAATTCGGCGGCAGCACGTCCAACCTTCAGGTTGGCCCAAGCCAGGAC
ACAACGTTCGGTTCGAACCAGGGCGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGTTGCTG
TGCCAGCTCATCTCGGCCCTGCTTCAGTCGAGCAAAAATGCTGAGGAGGGTAAGGGTCAGGGTGGC
GATAATGGCGGTGGCCAGGGCGGCAATTCGCAGCAGGCTGGGCAGCAGAATGGCCCCTCGCCATTC
ACCCAGATGCTGATGCATATCGTCGGAGAGATTCTCCAGGCGCAGAATGGTGGTGGTGCTGGTGGC
GGCGGGTTCGGCGGCGGGTTCGGCGGTGACTTTAGTGGCGACCTCGGCCTCGGCACCAACCTCTCG
AGCGACAGCGCATCGATGCAGTAA

FIGURE 4 (continued)

SEQ ID NO: 22, AAC95121.2| Hpa1 [Xanthomonas oryzae pv. oryzae]
MNSLNTQFGGSTSNLQVGPSQDTTFGSNQGGNQGISEKQLDQLLCQLISALLQSSKNAEEGKGQGG
DNGGGQGGNSQQAGQQNGPSPFTQMLMHIVGEILQAQNGGGAGGGGFGGGFGGDFSGDLGLGTNLS
SDSASMQ

SEQ ID NO: 23, gi|50428340:1138-1557 Xanthomonas oryzae pv. oryzae hrp gene cluster, complete cds
ATGAATTCTTTGAACACACAATTCGGCGGCAGCACGTCCAACCTTCAGGTTGGCCCAAGCCAGGAC
ACAACGTTCGGTTCGAACCAGGGCGGCAACCAGGGCATCTCGGAAAAGCAACTGGACCAGTTGCTG
TGCCAGCTCATCTCGGCCCTGCTTCAGTCGAGCAAAAATGCTGAGGAGGGTAAGGGTCAGGGTGGC
GATAATGGCGGTGGCCAGGGCGGCAATTCGCAGCAGGCCGGGCAGCAGAATGGCCCCTCGCCATTC
ACCCAGATGCTGATGCATATCGTCGGAGAGATTCTCCAGGCGCAGAATGGTGGTGGTGCTGGTGGC
GGCGGGTTCGGCGGCGGGTTCGGCGGTGACTTTAGTGGCGACCTCGGCCTCGGCACCAACCTCTCG
AGCGACAGCGCATCGATGCAGTAA

SEQ ID NO: 24, BAD29979, Hpa1 [Xanthomonas oryzae pv. oryzae]
MNSLNTQFGGSTSNLQVGPSQDTTFGSNQGGNQGISEKQLDQLLCQLISALLQSSKNAEEGKGQGG
DNGGGQGGNSQQAGQQNGPSPFTQMLMHIVGEILQAQNGGGAGGGGFGGGFGGDFSGDLGLGTNLS
SDSASMQ

SEQ ID NO: 25, gi|82393799:1-378 Xanthomonas oryzae pv. oryzicola hpaGXooc gene, complete cds
ATGAATTCTTTGAACACACAATTCGGCGGCAGCGCGTCCAACTTCCAGGTTGACCAAAGCCAGAAC
GCGCAATCCGATTCGAGCCAGGGCAGCAATGGCAGCCAGGGTATCTCGGAAAAGCAACTGGACCAG
TTGCTGTGCCAGCTCATCCAGGCCCTGCTTCAGCCGAACAAAAATGCTGAGGAAGGTAAGGGTCAG
CAGGGTGGCGAGAATAATCAGCAGGCCGGGAAGGAGAATGGCGCCTCGCCACTCACCCAGATGCTG
ATGAATATCGTCGGAGAGATTCTCCAGGCGCAGAATGCCGGCGGCAGCAGCGGCGGCGACTTTGGT
GGCAGTTTCGCCAGCAGCTTCTCGAACGACAGCGGATCGATGCAGTAA

SEQ ID NO: 26, ABB72197, hpaGXooc [Xanthomonas oryzae pv. oryzicola]
MNSLNTQFGGSASNFQVDQSQNAQSDSSQGSNGSQGISEKQLDQLLCQLIQALLQPNKNAEEGKGQ
QGGENNQQAGKENGASPLTQMLMNIVGEILQAQNAGGSSGGDFGGSFASSFSNDSGSMQ

SEQ ID NO: 27, gi|21112286:70-435 Xanthomonas campestris pv. campestris str. ATCC 33913, section 131 of 460 of the complete genome
TCAGGCTTGGCCGGTGATGCTCGACAGGTTGGCATTGAAGCCGCCACCCAAGCTGGTGCCGCCCAT
GCCGGCGCCGCCTTGGTTCTGCATCAGCTGCATCACGATCTGCATCAGCATCTGCGTCAACGGACT
CACACCGTCCTGTTGACCGCTCTGCGGTTGTTCGTCTCCGCACTCCTGATCGGCATCGCTGCCCTG
GCTCTGTTGGAGCATCATCATGATGAACATGGCGAGCAGCTGATCCAGCTGCTGCTCGGAGTCAGC
CGAAGGCGAGCGCTGACTGGAGTTCTGGGTTTGCTGGGGCCCGATGCCCATCGTCTGCAGGTTGAT
GAAGTTGGAAAATTTGTTTCCGATAGATGAGTCCAT

SEQ ID NO: 28, AAM40538, Hpa1 protein [Xanthomonas campestris pv. campestris str. ATCC 33913]
MDSSIGNKFSNFINLQTMGIGPQQTQNSSQRSPSADSEQQLDQLLAMFIMMMLQQSQGSDADQECG
DEQPQSGQQDGVSPLTQMLMQIVMQLMQNQGGAGMGGTSLGGGFNANLSSITGQA

FIGURE 4 (continued)

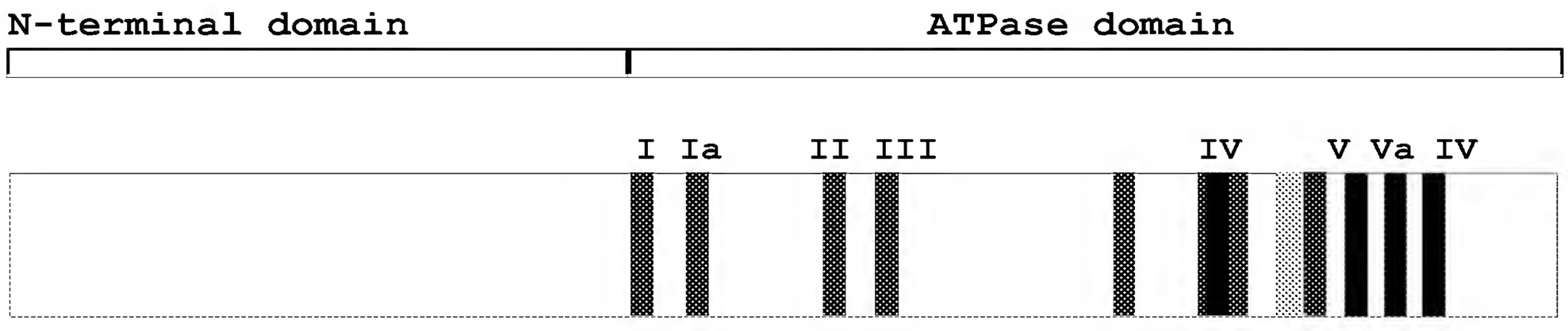

FIGURE 5

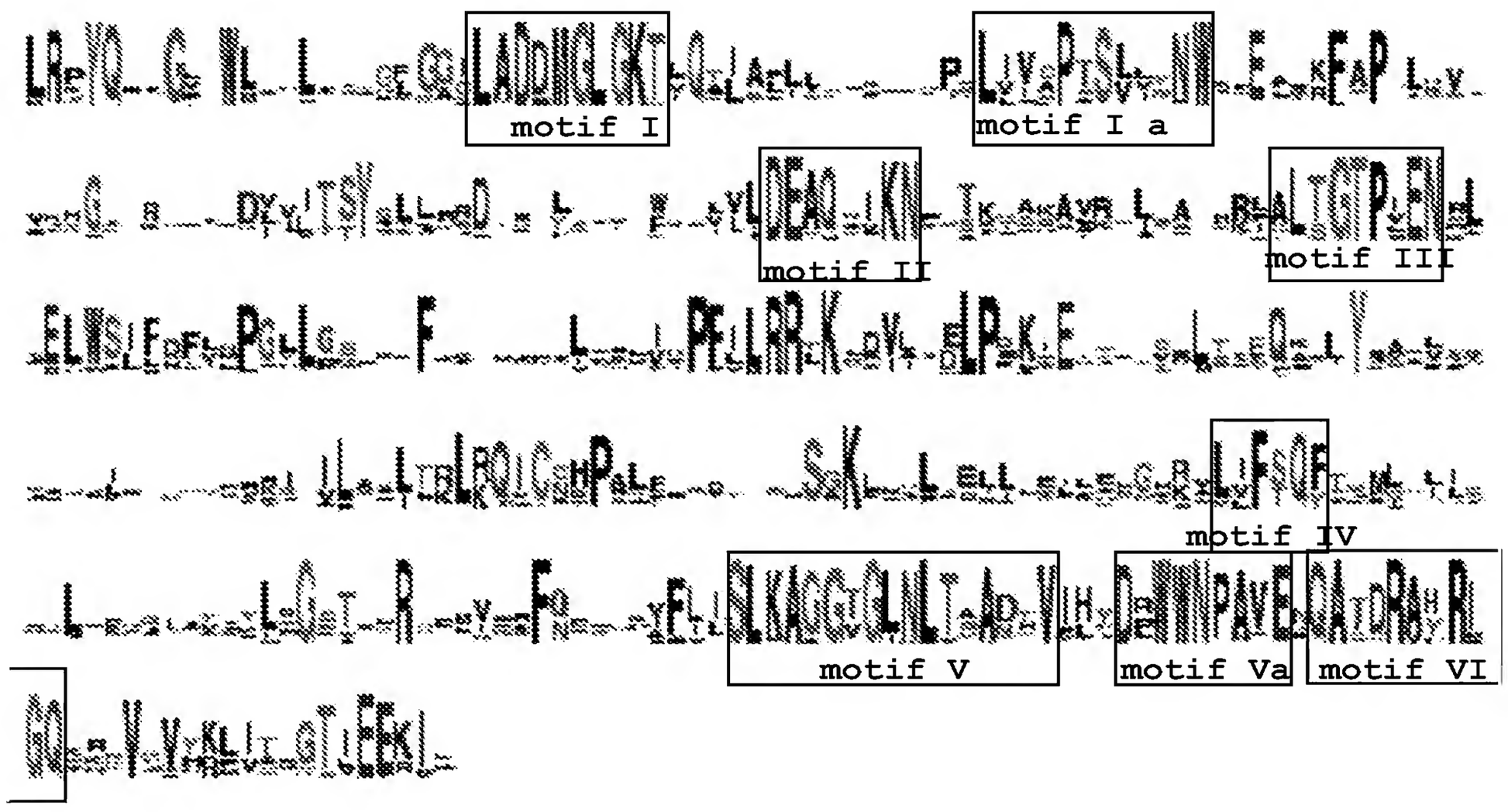

FIGURE 6

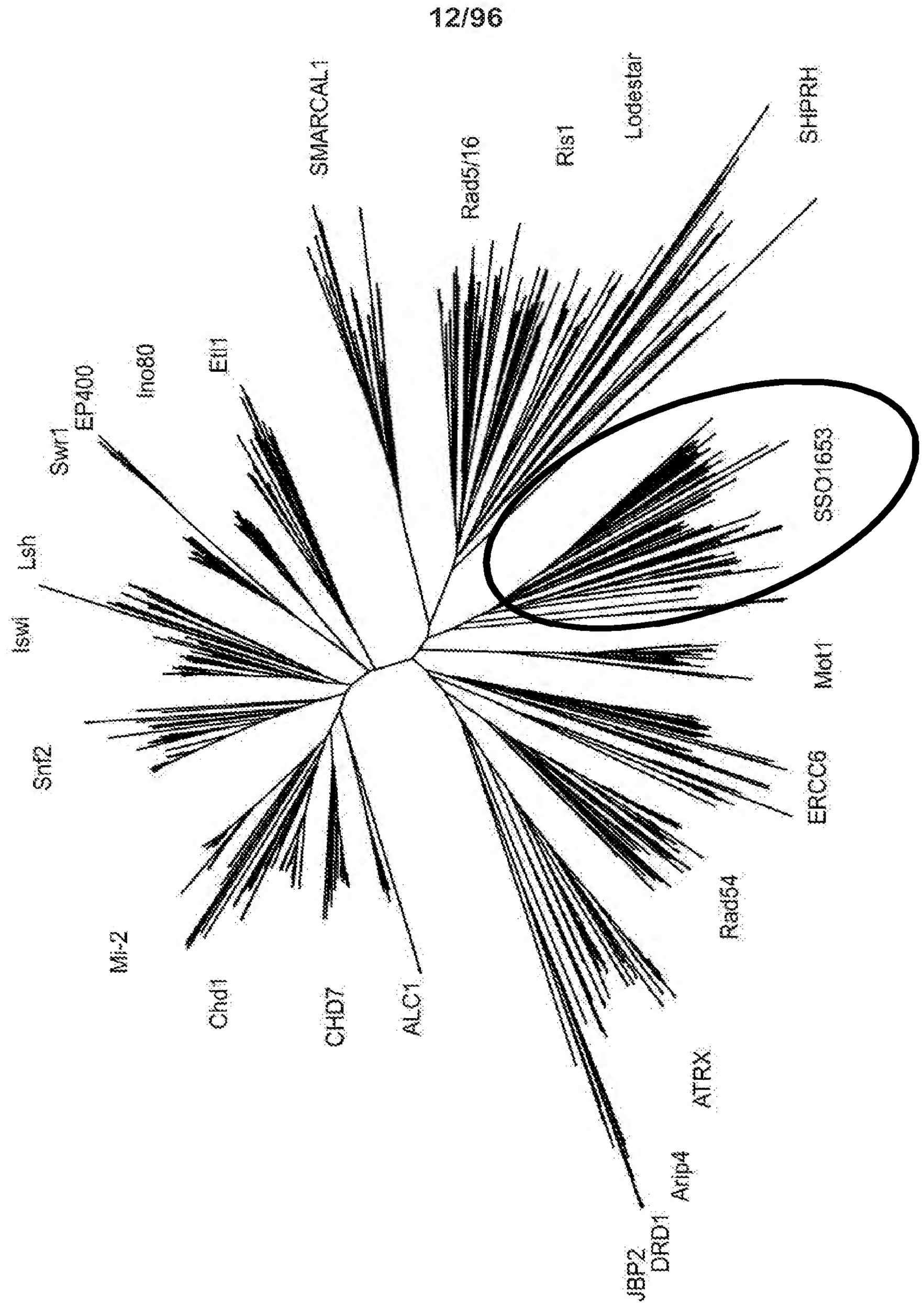
SMARCAL1
Rad5/16
Ris1
Lodestar
SHPRH
Ino80
Eti1
Swr1
EP400
Isw1
Lsh
Snf2
Mi-2
Chd1
CHD7
ALC1
Rad54
ERCC6
Mot1
SSO1653
JBP2
DRD1
Arip4
ATRX

FIGURE 7

FIGURE 8

```
CLUSTAL W (1.83) multiple sequence alignment

Synco_SNF2                      ---------------------------------MATIHGNWQPSHGEN--- 15
Anava_SNF2                      ---------------------------------MAILHGSWILSEQDS--- 15
Nostoc_SNF2                     ---------------------------------MAILHGSWILNEQES--- 15
Nodsp_SNF2                      ---------------------------------MAILHGNWLVRNQNG--- 15
Lyn_sp_SNF2                     ---------------------------------MAILHGSWLQHPKN---- 14
Crowa_SNF2                      ---------------------------------MTILHGTWIENTSEK--- 15
Synel_PCC6301_SNF2              ---------------------------------MAVLHGGWLGD------- 11
Synel_PCC7942_SNF2              ---------------------------------MAVLHGGWLGD------- 11
Theel_BP-1_SNF2                 ---------------------------------MAIFHGTWLPEPAP---- 14
Glovi_SNF2                      ---------------------------------MAILHGIWVHQPPRA--- 15
Proma_CCMP1375_SNF2             ---------------------------------MTLLHATWISTNWHPSNL 18
Proma_MIT\9211_SNF2             ---------------------------------MSLLHATWLPAMRTGSSH 18
Proma_MIT\9303_SNF2             MIGCGTPAWMVAVDRQCTPAPRNPTHTFCVAAMSLLHATWLPAIRTPTSS 50
Proma_MIT9313_SNF2              MIGCGTPAWMVAVDRQCTPAPRNPTHTFCVAAMSLLHATWLPAIRTPTSS 50
Syn_sp_CC9311_SNF2              ---------------------------------MSLLHATWLPAIRTPTSS 18
Syn_sp_WH\7805_SNF2             ---------------------------------MSLLHATWLPAIRTPSSS 18
Syn_sp_RS9916_SNF2              ---------------------------------MSLLHATWLPAIRTPTSS 18
Syn_sp_CC9605_SNF2              ---------------------------------MSLLHATWLPAIRTSSSS 18
Syn_sp_WH\8102_SNF2             ---------------------------------MSLLHATWLPAIRTSGSS 18
Syn_sp_CC9902_SNF2              ---------------------------------MSLLHATWLPAIRTSSSS 18
Syn_sp_\WH\5701_SNF2            ---------------------------------MSLLHATWLSADTAAVPA 18
Myctu_SNF2                      ---------------------------------MLVLHGFWSNSG------ 12
Mycbo_SNF2                      ---------------------------------MLVLHGFWSNSG------ 12
Nocfa_IFM\10152_SNF2            ---------------------------------MVGAGGPPGVG------ 11
Myxxa_DK_SNF2                   -------------------VRAWRGVLRWAAAGLSLSAARSPTGHLPVFS 31
Symth_IAM14863_SNF2             ---------------------------------MITVHGSFVPSG------ 12
Metac_C2A_SNF2                  ---------------------------------MIILH-----AGRVG--- 10
Metma_Go1_SNF2                  ---------------------------------MIILH-----AGRVG--- 10
Pelph_BU-1_SNF2                 ---------------------------------MIALH-----ISIID--- 10
Archaeon\RC-I_SNF2              ---------------------------------MITLHGTWTTVDPLN--- 15
Nos_sp_PCC7120_SNF2\II          ---------------------------------MKVLHGSWIPNQYSDFVQ 18
Bacce_ATCC10987_SNF2            ------------------------------------------------
Methu_JF-1_SNF2                 -------------------VTAKRPAPIHDKEEETIPDTSLPVFHALIYP 31
```

FIGURE 8 (continued)

```
Synco_SNF2                    ------GGKLFLWADTWGHPLPETIG------DRHPFALDLPDLLQAWSN 53
Anava_SNF2                    --------YLFIWGETWRSPQVNFSF---EEIALNPLALSASELSEWLQS 54
Nostoc_SNF2                   --------CLFIWGETWRSPQVDFNF---AEISLNPLALSALELSEWLQS 54
Nodsp_SNF2                    --------CLFIWGETWRSSRVDFALNVSQDIPLHPLVMSPIDLSELLSY 57
Lyn_sp_SNF2                   --------YLFIWGETWRR-ITPNEFNPADGVLGYPFALSPVELEKWCSE 55
Crowa_SNF2                    --------HFFIWGETWRSLSSDISSD--DSILMYPFSVDKQGIIEQLNS 55
Synel_PCC6301_SNF2            --------RFCVWAEAWQAGEPQSAAEIAIH----PYAIAATDLNDWCQK 49
Synel_PCC7942_SNF2            --------RFCVWAEAWQAGEPQSAAEIAIH----PYAIAATDLNDWCQK 49
Theel_BP-1_SNF2               --------QFFIWAEEWRS------LAQAIT----PWAPPAIPVYPYATQ 46
Glovi_SNF2                    ------G--LFLWGETWRQVAKRRKRS--EAPAPHPYVQQPAELSPRLAA 55
Proma_CCMP1375_SNF2           G-----QSELFLWADQWRVVTPKQIIQ---TPSPHPFSLSSDELKEWLNS 60
Proma_MIT\9211_SNF2           N-----PG-LLIWADSWRVAKPSIVSN---QPVIHPFALSAADLRIWLLQ 59
Proma_MIT\9303_SNF2           G-----RPALLVWADTWRVATPAGPAA---TPALHPFTLNPDDLRAWLIE 92
Proma_MIT9313_SNF2            G-----RPALLVWADTWRVATPAGPAA---TPALHPFTLSPDDLRAWLIE 92
Syn_sp_CC9311_SNF2            G-----RAALLVWADTWRVAEPAGPST---TPALHPFTLSPDDLRALLTE 60
Syn_sp_WH\7805_SNF2           G-----RAALLVWADTWRVADPLGPGA---TPALHPFTLSAEDLRAWLTE 60
Syn_sp_RS9916_SNF2            G-----RAALLVWADTWRVAEPAGPGV---TPATHPFTLSADDLRAWLSE 60
Syn_sp_CC9605_SNF2            G-----QPALLVWADTWRVATPEGPGL---TPALHPFTLSHEDLRAWLSE 60
Syn_sp_WH\8102_SNF2           G-----QPALLIWADTWRVATPEGPGL---TPALHPFTLEPDDLKAWLQE 60
Syn_sp_CC9902_SNF2            G-----QPALLIWADTWRVASPEGPGL---TPALHPFTLGSDDLKAWLTE 60
Syn_sp_\WH\5701_SNF2          LGGG-YRPGLLLWADTWRVAEPQTPAS---EAPQHPLSLDQDDLGAWLEE 64
Myctu_SNF2                    --------GMRLWAEDSD-LLVKSPSQA--------LRSARPHPFAAPAD 45
Mycbo_SNF2                    --------GMRLWAEDSD-LLVKSPSQA--------LRSARPHPFAAPAD 45
Nocfa_IFM\10152_SNF2          --------ATCLDGRMLHGLWSPGSGLV--------LWTEGEVPPALP-- 43
Myxxa_DK_SNF2                 GFSVATDGVGLFAGLSVRALVHQGPGGG--------PLRAPHGQPGRPAA 73
Symth_IAM14863_SNF2           -----ASGFFFLWGLDGVAARDAAPPG-----------RRRRGVPRHPCA 46
Metac_C2A_SNF2                -------KQFFLWGESPAENETPPVRRGRKPKKPVAKPYPYDSGVENLSS 53
Metma_Go1_SNF2                -------KQFFLWGESPAENETPVVRRGRKPKTPIVKPYPYDSGFENLSS 53
Pelph_BU-1_SNF2               -------GVPLLWSEGKKIGMLKELRLAT-------------AGIGMFS- 39
Archaeon\RC-I_SNF2            -------GTFFLWGESD--PATQHKRRGRPRKSAGEKQHPFHAGIKELEA 56
Nos_sp_PCC7120_SNF2\II        S------GAFYLWVETPINNKKRTHTQVHPGHLSSLELLNFLTQTLGIKE 62
Bacce_ATCC10987_SNF2          -------------MINQTEVTIRLQHVSHG-------------------- 17
Methu_JF-1_SNF2               AVEG---VAICAEYITDKPAPVRKKGYAKDKPGEYPYSLDHTALKTLIEN 78
```

FIGURE 8 (continued)

```
Synco_SNF2                  LPLAFPKADGVT----------------------EAALTLHLPSHRQQK- 80
Anava_SNF2                  QHQAIAQILPQQ-----LAKKTSKAASSPTTNLPIHSQIIVLPTEISQPR 99
Nostoc_SNF2                 QHQAIAKLLPQQ-----LEKRTSKAASSVKINLLTHSQIIALPTEISQPR 99
Nodsp_SNF2                  HNIKIPSLIQQSQVALSGTGRTRKSTSTTKFSWTTHSLIIDLPTHISENN 107
Lyn_sp_SNF2                 KQLSIESKVVVT-----------------------ETLALPTKLSP-- 78
Crowa_SNF2                  NKIKIEKNKNIES----------------------VSQIFYLPSKFIAK- 82
Synel_PCC6301_SNF2          YRLGS-LTGTPT-----------------------EVLLSIPSDLKKE- 73
Synel_PCC7942_SNF2          YRLGS-LTGTPT-----------------------EVLLSIPSDLKKE- 73
Theel_BP-1_SNF2             RKTPLRKTARPS-----------------------ATYVALPAQIQGH- 71
Glovi_SNF2                  QFPQIPLSLLVP-----------------------ETLALQLPATVEN-- 80
Proma_CCMP1375_SNF2         KKLLPNESINTS-----------------------ACLTLPSKPIH-- 83
Proma_MIT\9211_SNF2         KKLLPKESIECT-----------------------ALLTLPSKSIKNS 84
Proma_MIT\9303_SNF2         RDLLPDEIIDAT-----------------------ACLTLPSRTVKPR 117
Proma_MIT9313_SNF2          RDLLPDEIIDAT-----------------------ACLTLPSRTVKPR 117
Syn_sp_CC9311_SNF2          RDLLPDGIIDAT-----------------------ACLTLPSRSVKPR 85
Syn_sp_WH\7805_SNF2         RDLLPDGIIDAT-----------------------ACLTLPSRSVKPR 85
Syn_sp_RS9916_SNF2          RELLPDGIIDAT-----------------------ACLTLPSRTVKPK 85
Syn_sp_CC9605_SNF2          RDLLPGGCIDAT-----------------------ACLTLPSRTVKLR 85
Syn_sp_WH\8102_SNF2         RDLLPGGSIDAT-----------------------ACLTLPSRTVKPR 85
Syn_sp_CC9902_SNF2          RDLMPGGSIDAT-----------------------ACLTLPSRSVKPR 85
Syn_sp_\WH\5701_SNF2        ADLWTEDFRPAG-----------------------ATLCLPSRRQGAR 89
Myctu_SNF2                  LIAGIHPGKPAT-----------------------AVLLLPSLRSAPL 70
Mycbo_SNF2                  LIAGIHPGKPAT-----------------------AVLLLPSLRSAPL 70
Nocfa_IFM\10152_SNF2        --------DPAG-----------------------ALLRASRFRHR-- 58
Myxxa_DK_SNF2               HGAGNPVQGRSQ-----------------------ACLRVPLARTEFT 98
Symth_IAM14863_SNF2         TEP--------------------------------EALYPALRGLPYL 62
Metac_C2A_SNF2              ALELLLGSTG----------------------RKKAEEINVWIPTAG--- 78
Metma_Go1_SNF2              ALELLLGSTD----------------------RKKAEKINVWTPTIG--- 78
Pelph_BU-1_SNF2             ----LLDNT-------------------------TKEFCVWLPCRE--- 56
Archaeon\RC-I_SNF2          GAGAINSSCIRHI----------------ADAGARAEQVLILPSATDRPL 90
Nos_sp_PCC7120_SNF2\II      TEAQLKQRICSK-----------------------YFALPTANNEP- 85
Bacce_ATCC10987_SNF2        -----------------------------------WFLWGEDDSGTP- 29
Methu_JF-1_SNF2             CFGAYDDLKATR-----------------------WIIYLPAEETVP- 102
```

FIGURE 8 (continued)

```
Synco_SNF2                  ----------------IPLPFVTGQDPVAMDAKYLHWRSWQVTGVNLTPS 114
Anava_SNF2                  KKET-----------IFISPVHSAALESDADSE-VYLQPWRVEGFCLPPS 137
Nostoc_SNF2                 KKET-----------ILISPVHSAALASESDSE-VYLQTWRVEGFCLPPS 137
Nodsp_SNF2                  PQEI-----------EFISPLHSATLGSEINSP-QYLQPWRVEGFCLNPT 145
Lyn_sp_SNF2                 --KI-----------GLYPLQSTPQTDSETDSESICLYPWKIEGICLNST 115
Crowa_SNF2                  --SK-----------QSIPLLSTELKDKDFEQGDIQLIAWKIEGIKLNVD 119
Synel_PCC6301_SNF2          ----------------AVLPFLSGQEIPDG-----ALLWSWQIPVLSLEAA 103
Synel_PCC7942_SNF2          ----------------AVLPFLSGQEIPDG-----ALLWSWQIPVLSLEAA 103
Theel_BP-1_SNF2             ----------------QLLPPP--LAEVQG-----ELLFLWQVPGWSIPAS 99
Glovi_SNF2                  ------------------VVYSASIAPEG---KLLELEPWLVEGFWLDGH 109
Proma_CCMP1375_SNF2         --KKNNQKSKNQKTGIESEWKGLPLQAHEEIATQYECWPWKVDGISLTTV 131
Proma_MIT\9211_SNF2         LDKKLNGVTDSQNTSDQPQWSGLPLQAGEPVTKQCEWWPWQVEGIAIKPS 134
Proma_MIT\9303_SNF2         SKAKNVSTESDEDKDHKTSWTGLPLQAGEPIPKQTEWWPWQVQGLAVEPA 167
Proma_MIT9313_SNF2          NKTKNVSTESDEAKDNKTSWTGLPLQAGEPIPKQTEWWPWQVQGLAVEPA 167
Syn_sp_CC9311_SNF2          KKR-----ETETSSTEQPSWTGLPLQAGEPIPKQTEWWPWQVQGLAIDPM 130
Syn_sp_WH\7805_SNF2         RPRG--SAAATPSSEEQPPWCGLPLQAGEPIPKTTEWWPWQVQGLAIEPM 133
Syn_sp_RS9916_SNF2          RKR------GETAPVDEG-WTGLPLQAGEPIPKQTEWWPWQVQGLAVEPG 128
Syn_sp_CC9605_SNF2          KSRS----TKEEPTPEPPGWTGLPMQAGEPIPKQTEWWPWQVQGLAVEPS 131
Syn_sp_WH\8102_SNF2         KSRS----KTAEPAPEEPIWTGLPMQAGEPIPKQTEWWPWQVQGLAVEPS 131
Syn_sp_CC9902_SNF2          KSRT----QPSEPAPEGPAWTGLPMQAGEPIPKQMEWWPWQVQGLAVEPS 131
Syn_sp_\WH\5701_SNF2        GKKK----------SDTSSWSGLPLQAGEPIPKSVEWWPWRVEGWWLEPG 129
Myctu_SNF2                  ----------------DSPELIRLAPRPAAR--TDPMLLAWTVPVVDLDPT 103
Mycbo_SNF2                  ----------------DSPELIRLAPRPAAR--TDPMLLAWTVPVVDLDPT 103
Nocfa_IFM\10152_SNF2        ------------------AQVLVPGPAG-----PQLT--QVRAHALVPQ 82
Myxxa_DK_SNF2               ----------------FAAMPLVFLPDAETLFLWGPDRLPRELAGLPETGD 133
Symth_IAM14863_SNF2         ----------------NTLSLVQWQPGPD---GVSPARVPGIALSVPN--- 91
Metac_C2A_SNF2              ----------------WNPIPSSPLVAEIPASKAELSLAPWTVHAYPLEAE 113
Metma_Go1_SNF2              ----------------GNPVPSSPLVAEISDSKAEPALAPCTVHAYPLEAE 113
Pelph_BU-1_SNF2             ----------------KKAVPSSPLVGAMPDLSDEEQLHAFPITALRLNFN 91
Archaeon\RC-I_SNF2          ----------------RSASPSALESGEETNPDSSLQFLPWTVTGINIKPG 125
Nos_sp_PCC7120_SNF2\II      ----------------LPSPELVKYLEVEVPEEYENFQYWQVTCYETVTS 119
Bacce_ATCC10987_SNF2        ----------------LSVTSWKRN------------AFTWHSTSFYG 49
Methu_JF-1_SNF2             ----------------PSSQFSSKKKPSPKEKKLPLVPMYIPVLLCPYE 135
```

FIGURE 8 (continued)

```
Synco_SNF2                  QTLTLLQSIPLGG----QALAN----------------LGSEFYFYGQL 143
Anava_SNF2                  AAVKFLTSLPLNI----TSTENAF--------------LGGDLRFWSQI 168
Nostoc_SNF2                 AAIKLLTSLPLNI----TSGENAF--------------LGGDLRFWSQI 168
Nodsp_SNF2                  EAIKFLAAVPLNA----AREEDTL--------------FGGDLRFWSQI 176
Lyn_sp_SNF2                 EAFDFLQSLPLGN----LTTENSF--------------IGSDLQFWSHL 146
Crowa_SNF2                  DTINILSQLPLGL----TNNDENY--------------IGDNLKFWTHI 150
Synel_PCC6301_SNF2          IAGQWLATLPLG-----SAEDHPW--------------LGPDLRFWSHI 133
Synel_PCC7942_SNF2          IAGQWLATLPLG-----SAEDHPW--------------LGPDLRFWSHI 133
Theel_BP-1_SNF2             EVLEQLHQLSL------HGQDSGS--------------IGDDLRYWLHV 128
Glovi_SNF2                  QAFELLLGVPLG-------GGDAS--------------IGDDLRFWSQC 137
Proma_CCMP1375_SNF2         EATEWLTKLPLS-------KKDSD--------------LSEELLWWAHL 159
Proma_MIT\9211_SNF2         EAASWLANLPLT-------KKDPE--------------LSEEILWWSHL 162
Proma_MIT\9303_SNF2         AATAWLSKLPLS-------GDHPD--------------LADELRWWSHL 195
Proma_MIT9313_SNF2          AATAWLSKLPLS-------GNHPD--------------LADELRWWSHL 195
Syn_sp_CC9311_SNF2          AATAWLSKLPLS-------GRHPD--------------LADELRWWSHM 158
Syn_sp_WH\7805_SNF2         AATAWLAKLPLS-------GHHPD--------------LADELRWWSHM 161
Syn_sp_RS9916_SNF2          AATAWLARLPLS-------GRHPD--------------LADELRWWSHM 156
Syn_sp_CC9605_SNF2          AATEWLSRLPLS-------GTNPD--------------LADELRWWSHL 159
Syn_sp_WH\8102_SNF2         AATEWLSRLPLS-------GRNPD--------------LADELRWWSHL 159
Syn_sp_CC9902_SNF2          AATEWLARLPLS-------GRHPD--------------LGDELRWWSHL 159
Syn_sp_\WH\5701_SNF2        AATLWLGRLPLS-------GDHPD--------------LADDLRWWSHL 157
Myctu_SNF2                  AALAAFDQP----------APDVR--------------YGASVDYLAEL 128
Mycbo_SNF2                  AALAAFDQP----------APDVR--------------YGASVDYLAEL 128
Nocfa_IFM\10152_SNF2        AAVDVLRQR----------LPVES--------------VAGDLRFLAHV 107
Myxxa_DK_SNF2               RASALLVTPEGLRECEGHGLPLAATVERLAVVQTSEAESFPGSIALWTLA 183
Symth_IAM14863_SNF2         AVQWLLDLPDHFR-----GTPLRP---------------GHSLQLWCVA 120
Metac_C2A_SNF2              EAIVLLCACMGKK------VLAPG-------------IISGNDLLWWADA 144
Metma_Go1_SNF2              EAIVLLCTCMEKK------VLAPG-------------IISGNDLLWWADA 144
Pelph_BU-1_SNF2             ALFELSLLTEKGN------IPGSG-------------IIFGSSLHWARQV 122
Archaeon\RC-I_SNF2          NALVLLSSIAESQ------KRIGD-------------MAIGPDLLYWSKV 156
Nos_sp_PCC7120_SNF2\II      VKAVIAINIIKLLKDIHFLALYNAS-----------EFQLGSDLLFWYHY 158
Bacce_ATCC10987_SNF2        TFLKEASFEGRQG-------------------------VMLTNAQAFEYI 74
Methu_JF-1_SNF2             TFFQIWKAAQNTD-------------------------KNYIAGDSFQYI 160
```

FIGURE 8 (continued)

```
Synco_SNF2                    HRWCLDLVLRGKFVPGLEQRGED-GNYYAQWIPILDSIQDQTHLAQFSQR 192
Anava_SNF2                    ARWSLDLISRSKFLPIIQRQPN--NSVSAKWQVLLDSAVDGTRLEKFAAK 216
Nostoc_SNF2                   ARWSLDLISRSKFLPIIQRQPN--NSVSAKWQVLLDSAVDGTRLEKFAAK 216
Nodsp_SNF2                    ARWSLDLISRCKFLPTIQRQFD--SSIVARWQVLLDSAIDGTRLEKFSAK 224
Lyn_sp_SNF2                   SRWSLDLLARSKFLPSLTFNPSK-DHFIAEWKPLLDSATDQARLIRFSKQ 195
Crowa_SNF2                    YRWSLDLLTRGKYLPQMEEQDN---NCYGQWEPLLDSLVDQQRFSKFIQT 197
Synel_PCC6301_SNF2            YRWAQSLLARGRFYPALESSDR---GLTAVWLPLFNQAGDRQRFDRYSQQ 180
Synel_PCC7942_SNF2            YRWAQSLLARGRFYPALESSDR---GLTAVWLPLFNQAGDRQRFDRYSQQ 180
Theel_BP-1_SNF2               SRWLLDLIVRGQYLPTPEG-----------WRILLTHGGDRDRLRHFSQL 167
Glovi_SNF2                    ARWVLDLLVRAKYLPDLESGDGQ-EIPTARWVPLLDSAVDQARLKEFAAR 186
Proma_CCMP1375_SNF2           ERWSLNLIASGLWLPQVKLHKKEGNEYRASWIPLLNQENERNRLEEFAKN 209
Proma_MIT\9211_SNF2           ERWSLSLIARGLWLPQVELNTIDNIGARARWSPLLNNENERKRLEEFSIR 212
Proma_MIT\9303_SNF2           QRWALSMIARGRWLPQVELSKGEGYPHRARWTPLLNREDDRRRLEDLAAQ 245
Proma_MIT9313_SNF2            QRWALSMIARGRWLPQVELSKGEGYPHRARWTPLLNREDDRRRLEDLAAQ 245
Syn_sp_CC9311_SNF2            QRWSLSLVARSRWLPQVELSKGEGYPHRARWVPLLNREEDRRRLEDLAAG 208
Syn_sp_WH\7805_SNF2           QRWALSLVARGRWLPQVELSRGEGYPHRARWVPLLNREEDRRRLEDLAAR 211
Syn_sp_RS9916_SNF2            QRWALSLIARSRWIPQVELSKGEGYPHRARWVPLLNREDDRRRLEDMAAR 206
Syn_sp_CC9605_SNF2            QRWALSLVARGRWIPQMEFSKGEGYPHRARWVPLLNREEDRRRLEDLAAS 209
Syn_sp_WH\8102_SNF2           QRWALSLVARGRWIPQMELSKGEGYPHRARWVPLLNREEDRRRLEDLAAS 209
Syn_sp_CC9902_SNF2            QRWSLSLVARGRWIPQMELSKGEGYPHRARWVPLLNREEDRRRLEDLAAT 209
Syn_sp_\WH\5701_SNF2          QRWSLSLLARGRLLPQVEGG-------RARWLPLINREDDRRRLEDLASR 200
Myctu_SNF2                    AVFARELVERGRVLPQLRRDTH---GAAACWRPVLQG-RDVVAMTSLVSA 174
Mycbo_SNF2                    AVFARELVERGRVLPQLRRDTH---GAAACWRPVLQG-RDVVAMTSLVSA 174
Nocfa_IFM\10152_SNF2          ADGIDRWVRAGRVVPDLHRADG---QWWARWRLVGGA-RQRAWLAELAVA 153
Myxxa_DK_SNF2                 SKLALELVARERVVPTLLRRGE---RIEARWAAALSATEDAGRVAALARS 230
Symth_IAM14863_SNF2           SKLLLEFLGRGLMLPVLQAEAG---VLSAGWALHLTDADDVRRLTRLAAG 167
Metac_C2A_SNF2                LKFAGSLVAGQKYLPGVRGGEG----EYKAFWEPVFSGEDAGELARLAKQ 190
Metma_Go1_SNF2                LKFAGSLVAGQKYLPGVRGGEG----EYRAFWEPVFSGEDAGKLAKLAKQ 190
Pelph_BU-1_SNF2               VKIALNIVRTQSLLPSIIKNDT----FWEALWLPLPDSATSLAVEQLADA 168
Archaeon\RC-I_SNF2            AKFTLKLLISQQFRPEVVEVMSG--KAYSRWRFALTDETDRKHYASLENS 204
Nos_sp_PCC7120_SNF2\II        TQSFRQIITKDQYIPSLKYRAN-AATTKKKPKQPPPGFEIYAGWEIISEQ 207
Bacce_ATCC10987_SNF2          ANKPMNSFARIQMNGPITALTEDANELWDAFTSGSFVPDMERWPKQPSWK 124
Methu_JF-1_SNF2               S-ILMESTVRLIQNGRFKPSLERTFAGYHAVWVPALSPQDMEWVSDFSSR 209
```

FIGURE 8 (continued)

```
Synco_SNF2                  VPACALANLT----------------------------DSQEPQMLVVD 213
Anava_SNF2                  MPLVCRTYQR-LGNEEL--------SPSP------IYIDFPSQPQELILG 251
Nostoc_SNF2                 MPLVCRTYQE-IGS-----------GESP------IYIDFPSQPQDLILG 248
Nodsp_SNF2                  MPLACRTYRKGMGSGEWGVGSGEESSPSI------MYVDFPTEPQELLLG 268
Lyn_sp_SNF2                 IPSACRIYQLWSKEAQN--------QFEN------LALDLPQNPQNLIDD 231
Crowa_SNF2                  MPNSSLAYHNLMEG---------------------ELSSSLLKQTTILD 225
Synel_PCC6301_SNF2          LPFSQFCYQAIETA---------------------AACPWQPQPQDLLLR 209
Synel_PCC7942_SNF2          LPFSQFCYQAIETA---------------------AACPWQPQPQDLLLR 209
Theel_BP-1_SNF2             MPDLCRCYQADGTA---------------------LQLP--PHAADLLAD 194
Glovi_SNF2                  LPGACRAATP----------------------------ELSPHQILKS 206
Proma_CCMP1375_SNF2         IPLVAICAVPWIEAKG----QIVNTEQVSNSNNNTLSLYRPRHNRVEVMD 255
Proma_MIT\9211_SNF2         LPLVATCAIKREETSEENQNHILKTTPRETLDEYGLAVCRPINSRLQVAY 262
Proma_MIT\9303_SNF2         LPLVATCALPWREPTGRRSNRMTRLRPEAMRAANPVASCRPRSGRLRVAS 295
Proma_MIT9313_SNF2          LPLVATCALPWREPTGRRSNRMTRLRPEAMRAANPVASCRPRSGRLRVAS 295
Syn_sp_CC9311_SNF2          LPLVATCALPWREPTGKRSNRITRLRPEAMRAANPVACCRPRSGRLRVAT 258
Syn_sp_WH\7805_SNF2         LPLVATCALPWREPTGKRSNRITRLRPEAMRAANPVACCRPRSGRLRVAT 261
Syn_sp_RS9916_SNF2          LPLVATCALPWREPTGKRSNRTTRLRPEAMRAANPVACCRPRSGRLRVAT 256
Syn_sp_CC9605_SNF2          LPLVATCALPWREPLGRRSNRTTRLRPEAMRAANPVASCRPRSGRLRVAT 259
Syn_sp_WH\8102_SNF2         LPLVATCALPWREPMGRRSNRMTRLRPEAMRAANPVACCRPRSGRLRVAT 259
Syn_sp_CC9902_SNF2          LPLVATCALPWREPLGRRSNRTTRLRPEAMRAANPVACCRPRSGRLRVAT 259
Syn_sp_\WH\5701_SNF2        LPQVAVAAL----------------EPGQGEAGVAMACWRPGSGRRRLAS 234
Myctu_SNF2                  MPPVCRAEVGG--------------------------HDPHELATSALDA 198
Mycbo_SNF2                  MPPVCRAEVGG--------------------------HDPHELATSALDA 198
Nocfa_IFM\10152_SNF2        MPAALRVAG----------------------------QPAAVLDDLVTE 174
Myxxa_DK_SNF2               MPPGAHAVPAGARPG----------------------RAVWAPDALLRA 257
Symth_IAM14863_SNF2         LPEACRALVPPDRTPN---------------------TYPLPVADGLVHQ 196
Metac_C2A_SNF2              MPPAAKALALETSSVQP----------------------EILAAVAARQ 217
Metma_Go1_SNF2              MPPAARALAPEASSMPP----------------------EMPAALAAKQ 217
Pelph_BU-1_SNF2             MPAVCRSLG-RTDTQPP----------------------ETPKKLLLKG 194
Archaeon\RC-I_SNF2          MPLACIAVSGKAGIYN----------------------------RKEALDL 227
Nos_sp_PCC7120_SNF2\II      YEANIQKYIEYMPLICVAG----------------NSTQTDKLEFFAPET 241
Bacce_ATCC10987_SNF2        VQNTP-------------------------------------IEDETLAS 137
Methu_JF-1_SNF2             MPTVCKYAIPRVAKDPY----------------------IYKPETRLEK 236
```

FIGURE 8 (continued)

```
Synco_SNF2                    LLQKLLQAQIGAVSPS--------LANVKEVWLNDWLRGLTHGGQTSLGT 255
Anava_SNF2                    FLNSAIDTQLREMVGNQPVV-ETRLMASLPSAVRQWLQGLSGASNSVDAD 300
Nostoc_SNF2                   FLNSAIDTQLREMVGNQPVV-ETRLMASLPSAVRQWLQALIAASNSIDAD 297
Nodsp_SNF2                    FLNSTIDAQVREMLASQPLL-ETRVMASLPSAVRQWLQGLTSASHTVNAD 317
Lyn_sp_SNF2                   FLTAIIDSQVKKVAEESEKK-AITNLTAIQPIVQSWLHALASESNLAKSK 280
Crowa_SNF2                    FLSTIINQQVRQFID---------VAITPSSFIQKWLYSLTQDLSKFEAS 266
Synel_PCC6301_SNF2            VLQTWLTARLQPAIAA--------GTLVSADLLAAWQQSLAN-GKPLKLE 250
Synel_PCC7942_SNF2            VLQTWLTARLQPAIAA--------GTLVSADLLAAWQQSLAN-GKPLKLE 250
Theel_BP-1_SNF2               FLQHTLQGYLHTALAD--------LELPKVGLAKEHGHWLAF-LKTGQTP 235
Glovi_SNF2                    FLSAMLDARVRTLLACEP----PDPRTLPAGAVRPWLLALAHAQPQLKSP 252
Proma_CCMP1375_SNF2           LLEELIDAQLRKDFQP--------RTKNLDPLLKAWQEALGTKDGIINLS 297
Proma_MIT\9211_SNF2           LLEELVDGQLRKDFEE--------SSEDLDPLLKAWQEALGSHNGVIRLP 304
Proma_MIT\9303_SNF2           LLEELLDAQLRTGFEA--------SEQGLDPLLTAWQEALGSDSGVINLP 337
Proma_MIT9313_SNF2            LLEELLDAQLRTGFEA--------SEQGLDPLLTAWQEALGSDSGVINLP 337
Syn_sp_CC9311_SNF2            LLADLMDAQLRKGFTP--------DPDGLDPLLRAWEEALSSDTGEIQLS 300
Syn_sp_WH\7805_SNF2           LLEDLVDAQLRKGFHP--------DDEGLDPLLCAWENALSSETGVIDLN 303
Syn_sp_RS9916_SNF2            LLEDLVDAQLRTGFTA--------QTDGLDPLLAAWEEALGSDTGVIHLG 298
Syn_sp_CC9605_SNF2            LLEDLVDAQLRKDFEP--------STDGLDPLLTLWQEALGSETGVIEIG 301
Syn_sp_WH\8102_SNF2           LLEDLVDAQLRKDFEP--------STDGLDPLLTLWQDALGSETGVIEIG 301
Syn_sp_CC9902_SNF2            LLEDLVDAELRKGFEP--------TTEGLDPLLTLWQEALASETGVVEVG 301
Syn_sp_\WH\5701_SNF2          ILTHLVDARMRAGFTP--------SEEGLDPLLAAWQRALGPGDGRLDLG 276
Myctu_SNF2                    MVDAAVRAALSPMDLLPPR---RGRS-KRHRAVEAWLTALTCPDGRFDAE 244
Mycbo_SNF2                    MVDAAVRAALSPMDLLPPR---RGRS-KRHRAVEAWLTALTCPDGRFDAE 244
Nocfa_IFM\10152_SNF2          LTDPIVRTRLADAPVTHPL---VRAL-VRDQPLETGSHQLAEVLRRWRES 220
Myxxa_DK_SNF2                 FLDATVDAFVRAARGAPSL---PARR--AASWDERWREALTGAR-RDFAP 301
Symth_IAM14863_SNF2           FMRTAAAGVIRLLLEEEPL---PEAQSLQDTALRHWLAALTGAEARDLPP 243
Metac_C2A_SNF2                FIEEALDWIVRSEIGEKELAKEARKRKSFDSVHDAWVSALKSPD-GLIHG 266
Metma_Go1_SNF2                FIEDSLDWIVRSEIGEKKLAKETRKRKSFDSVHDAWVSALRSPE-GLIYG 266
Pelph_BU-1_SNF2               LLSFLVNTLSRTFERAG-----VPKISDFESIHDAWLHALSNSDPRLKWK 239
Archaeon\RC-I_SNF2            FINTALDTFIRDQIALP------ADSRMTNLLSQAWLDSLGTGE--SIRL 269
Nos_sp_PCC7120_SNF2\II        LLRHFSEYLLNNLVSKTP------LTAAFEKQIDDSLIHYCLYPQKHNPL 285
Bacce_ATCC10987_SNF2          LFSAAVNESILQDNRSND------GWEDAKRLYEHYDFTKRQLDAALHEE 181
Methu_JF-1_SNF2               FIVEMMRVIIRTALGGYT------LKEETDPFYEPSENEMQFMTDLLGVT 280
                              .
```

FIGURE 8 (continued)

```
Synco_SNF2                  S--KALQRLATSLDHWYLPVQNYLGQKNNQALAQRQWRGALRLQPPADDG 303
Anava_SNF2                  A--VGLERLEAALKAWTMPLQYQLASK-------NQFRTCFELRSPEPG- 340
Nostoc_SNF2                 A--VGLERLEAALKAWTMPLQYQLASK-------NQFRTCFELRSPEPD- 337
Nodsp_SNF2                  A--MEVERLEAALKSWTMPLQYQLVGK-------PSFRACFQLLPPASG- 357
Lyn_sp_SNF2                 K--SESKTLEKILSNWTAPLQQTLAEH-------NLFRTGFRLSPPENN- 320
Crowa_SNF2                  E--VERKGLKNAINNWKSSLSEYIIKSDNQPLGINQFRVCFKLENPAKSG 314
Synel_PCC6301_SNF2          D--SEASRLQTAIDRWLLP--VQNGAA-------QAWRMVLRLVPPTEQ- 288
Synel_PCC7942_SNF2          D--SEASRLQTAIDRWLLP--VQNGAA-------QAWRMVLRLVPPTEQ- 288
Theel_BP-1_SNF2             E--LPPP-LIERLHRWQEPYREQLHLR-------PQWRLALQLVPPDTA- 274
Glovi_SNF2                  D--PETPALAEALATWRAPLSYQVRSR-----------TCFRLQPPEES- 288
Proma_CCMP1375_SNF2         N--ENAKRLEKASKNWKRGLSSNVQPA----------KTCLELIAPIDD- 334
Proma_MIT\9211_SNF2         L--EDCERLAKASKNWKENLSGNVKGA----------RACLELFAPLEG- 341
Proma_MIT\9303_SNF2         D--EEAERLATASNHWREGVAGNVAPA----------RACLELFTPGEG- 374
Proma_MIT9313_SNF2          D--EEAERLATASNHWREGVAGNVAPA----------RACLELFTPGEG- 374
Syn_sp_CC9311_SNF2          D--EETERLATASNHWREGVAGNVAAA----------RACLELATPADD- 337
Syn_sp_WH\7805_SNF2         D--EDAERLATASHHWREGVAGNVAAA----------RACLELATPNEG- 340
Syn_sp_RS9916_SNF2          D--EDAERLATASHHWREGVAGTVAAA----------RACLELETPDDG- 335
Syn_sp_CC9605_SNF2          D--EEAERLATASHHWREGIAGDFAAA----------RTCLELHTPPDG- 338
Syn_sp_WH\8102_SNF2         D--EQAERLASASFHWREGIAGDFAAA----------RTCLELQTPAEG- 338
Syn_sp_CC9902_SNF2          N--EDAERLTAASLHWREGIAGGFAAA----------RTCLELNTPNEG- 338
Syn_sp_\WH\5701_SNF2        D--DDCERLQVATHHWREAVAGRVEPA----------RACLELDTPDEG- 313
Myctu_SNF2                  P--DELDALAEALRPWDDVGIGTVGPAR-----ATFRLSEVETENEETPA 287
Mycbo_SNF2                  P--DELDALAEALRPWDDVGIGTVGPAR-----ATFRLSEVETENEETPA 287
Nocfa_IFM\10152_SNF2        LTVDEPELVLRLLEPDGETGIDGDG----------------GDDRDDTVA 254
Myxxa_DK_SNF2               EGFAERSVVDELTR-WSEPALGAR----------DKLRACFRLEPPTEER 340
Symth_IAM14863_SNF2         GLPGAQELYAALDR-WSAPATGVLS--------HASLRTGVRLHLPGPET 284
Metac_C2A_SNF2              EE-KELLQLAFRTREWQRPLTVLTTSP---------FRFCFRLEEPAAEE 306
Metma_Go1_SNF2              DE-NELLQLAARTREWQRPLTILTTSP---------FRFCFRLEEPALEE 306
Pelph_BU-1_SNF2             NE-QEIEQFACQLNAWRRPIDLHERSP---------FRFCLQLTEP---- 275
Archaeon\RC-I_SNF2          SA-PEMKKLKDSAGRWTSRMKTESKQA---------LKTCFILEPPAP-- 307
Nos_sp_PCC7120_SNF2\II      KTHTALQEYQQWLGWKNRIIRTQAESP---------FHLCFQLHSPDAEQ 326
Bacce_ATCC10987_SNF2        DWLRKIGYIEDDL----------------------PFTIGLRLQEPQE-- 207
Methu_JF-1_SNF2             DPIRNKGFERTFLRAMQDWLTFSSSGRF------APFEFCMIIKDPPEG- 323
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```
Synco_SNF2                    ----------------------------------GGTWQLDYGLQALDDG 319
Anava_SNF2                    ----------------------------------ETEWTLAYFLQAADNP 356
Nostoc_SNF2                   ----------------------------------ETEWTLAYFLQAADDP 353
Nodsp_SNF2                    ----------------------------------ATDWILAYFLQAADDE 373
Lyn_sp_SNF2                   ----------------------------------QKNWTLDYCLQAIDEP 336
Crowa_SNF2                    KK------------------------------LEQSNWQLHYYLQALDDP 334
Synel_PCC6301_SNF2            ----------------------------------EQPWQLEFGLQAATDP 304
Synel_PCC7942_SNF2            ----------------------------------EQPWQLEFGLQAATDP 304
Theel_BP-1_SNF2               ----------------------------------DGDWHLAFGLQTEGET 290
Glovi_SNF2                    ----------------------------------QGEWKLHFLLQTGDDP 304
Proma_CCMP1375_SNF2           ----------------------------------LDLWDLNFSLQSESDP 350
Proma_MIT\9211_SNF2           ----------------------------------EDLWDLQFSLQAEADP 357
Proma_MIT\9303_SNF2           ----------------------------------EDLWELRFALQAEADP 390
Proma_MIT9313_SNF2            ----------------------------------EDLWELRFSLQAEADP 390
Syn_sp_CC9311_SNF2            ----------------------------------EDLWPLRFFLQAEADP 353
Syn_sp_WH\7805_SNF2           ----------------------------------EELWDLRFYLQAEADP 356
Syn_sp_RS9916_SNF2            ----------------------------------DDLWTLRFALQAEADP 351
Syn_sp_CC9605_SNF2            ----------------------------------EDLWELRFGLQAEADP 354
Syn_sp_WH\8102_SNF2           ----------------------------------EELWELRFGLQAESDP 354
Syn_sp_CC9902_SNF2            ----------------------------------EELWDLKFGLQAEADP 354
Syn_sp_\WH\5701_SNF2          ----------------------------------EDLWPLRFSLQAEADP 329
Myctu_SNF2                    G---------------------------------SLWRLEFLLQSTQDP 303
Mycbo_SNF2                    G---------------------------------SLWRLEFLLQSTQDP 303
Nocfa_IFM\10152_SNF2          ----------------------------------LWRLEVCLRTEGEA 268
Myxxa_DK_SNF2                 E---------------------------------PFVLSFHLQSPDDP 355
Symth_IAM14863_SNF2           D---------------------------------GEWELELTLHAPDEG 300
Metac_C2A_SNF2                ELEETEE------SEAGKMDTKKGRKGIADIEVPEELWYVRYMLQSYEDP 350
Metma_Go1_SNF2                EIEETEETEEIEENEAGKRDTKKGREGIADIEVPEGLWYVRYMLQSYEDP 356
Pelph_BU-1_SNF2               --------------------PLKGRK--------KERWHVAYQLQLKADP 297
Archaeon\RC-I_SNF2            ----------------------------DTEYPEAPWNLRYCLQASDDP 328
Nos_sp_PCC7120_SNF2\II        ----------------------------------IDNWQMQFLVSSKKDP 342
Bacce_ATCC10987_SNF2          ----------------------------------EFEMWKLETIVTPKRGA 224
Methu_JF-1_SNF2               ----------------------------------QTEPWDFTLAVRSEAEP 340
                                                                  : .   :
```

FIGURE 8 (continued)

FIGURE 8 (continued)

```
Synco_SNF2                    EFWLPAASLWAMAGDRLVWQGRRV-DQGAESLLRGLGVAAQIYEPIAASL 368
Anava_SNF2                    EFLVDAGTIWQHPVEQLIYQQRSI-QEPQETFLRGLGLASRLYPVIAPTL 405
Nostoc_SNF2                   EFLVDAATIWQNPVEQLIYQQRTI-EEPQETFLRGLGLASRLYPVIAPTL 402
Nodsp_SNF2                    NLLVDAATIWHHPVEQLVYQNRTI-DQPQETLLRGLGLASRLYPVLTPSL 422
Lyn_sp_SNF2                   EFLVDAQTIWTHPVEAFVHNGRMI-KRPQETLLKGLGLASKLYPLLEPSL 385
Crowa_SNF2                    NFLISAKVIWENPVTRLICNNRTI-NHPQETLLKGLGLASRLYYLIEESL 383
Synel_PCC6301_SNF2            DRFRPASLLWQDPLPPGLPD------QSQELLLRGLGQACRLYPQLQTSL 348
Synel_PCC7942_SNF2            DRFWPASLLWQDPLPPGLPD------QSQELLLRGLGQACRLYPQLQTSL 348
Theel_BP-1_SNF2               DTMLRAAEIWQCTQEALLYQGQVL-WQPQETLLRGLGLASRIYRPLDRSL 339
Glovi_SNF2                    DSLMAAQQVWSSAG------------ELQEVFLAGLGLASRIFVPVERGL 342
Proma_CCMP1375_SNF2           SIRLAADQIWEAGVEVTKVGGITI-DNPSEILLEGLGRSLEIFPPIEKGL 399
Proma_MIT\9211_SNF2           SLKVAAEAVWNADSAVLQIGDIQI-AQPGEILLEGLGRALNIFQPIERGL 406
Proma_MIT\9303_SNF2           TIKVPAAAAWAAGPKVLQLGEIRV-EHPGEVLLEGMGRALTVFAPIERGL 439
Proma_MIT9313_SNF2            TIKVPAAAAWAAGPKVLQLGEIRV-EHPGEVLLEGMGRALTVFAPIERGL 439
Syn_sp_CC9311_SNF2            TLKLPAGAAWAAGPSGLQLGEIKV-EHPSEVLLEGMGRALTVFQPIERGL 402
Syn_sp_WH\7805_SNF2           TLKVPAGAAWAAGPEGLQLGEIPV-EHPGEVLLEGMGRALTVFEPIERGL 405
Syn_sp_RS9916_SNF2            TLKVPAALAWAAGPKGLQLGEIAV-EHPGELLLEGMGRALTVFPPIERGL 400
Syn_sp_CC9605_SNF2            SLKLPAAAAWAAGAEPLQLGEIRV-DQPGEVLLEGMGRALSVFPAIERGL 403
Syn_sp_WH\8102_SNF2           SLKLPAAAAWASGADQLQLGEVTV-EQPGEVLLEGLGRALTVFPPIERGL 403
Syn_sp_CC9902_SNF2            SLKLPAAAAWASGAETLQLGEIKV-DQAGEVLLEGLGRALTVFPPIERGL 403
Syn_sp_\WH\5701_SNF2          SLLLPAAGVWAAGAGCLQLGETEL-QQPGELLLEGLGRALQVFEPIERGL 378
Myctu_SNF2                    SLLVPAEQAWNDDGS----LRRWL-DRPQELLLTELGRASRIFPELVPAL 348
Mycbo_SNF2                    SLLVPAEQAWNDDGS----LRRWL-DRPQELLLTELGRASRIFPELVPAL 348
Nocfa_IFM\10152_SNF2          PAPVPATADPN--------LLR--------IAVEQLGRAQRAYPRLRDLP 302
Myxxa_DK_SNF2                 SLLVPAADVWKTRGRSLEKLGRAF-RDPQESLLEALGRAARLFPPLALVL 404
Symth_IAM14863_SNF2           ALPVTADAVWASLGAEVEIGGQRY-QGAEQRLLADLPAMARLFPPLAPLL 349
Metac_C2A_SNF2                SLLIPVKEAWKPK-KGSPLKRYDV-KNIRQFLLSSLGQAAGISAGIASSL 398
Metma_Go1_SNF2                SLLIPVKEAWKPK-KGSPLKKYDV-KNIRQFLLSSLGQASSISAGIASSL 404
Pelph_BU-1_SNF2               SLILDAGDLWNPESEASQHALTYT-SDCTEFLLTSLGQASGLCPAVTQSL 346
Archaeon\RC-I_SNF2            SLVIPAETVWKELKKTLKYLNKRY-DNPQEQLLQDLGKAMQMFPEIEPSL 377
Nos_sp_PCC7120_SNF2\II        SLKLALADYWIMNSKTKAGVHKEFGKDFDTNLLLNLGYAARMYPKLWQGL 392
Bacce_ATCC10987_SNF2          HRIYVYESIDSLPKRWH--------DYEERILET-----QESFSKLVPWL 261
Methu_JF-1_SNF2               SLLIPAEIIWELPDHQSGLFPQA--AYLKHILLAGIGLLTSSSSALWRPL 388
                                                                                :
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FIGURE 8 (continued)

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Synco_SNF2                    TERCPTGCGLDAIQAYEFILAIAHQLRDRGLGVILPPGLERG-GTAKRLG 417
Anava_SNF2                    DTESPQFCHLNPMQAYEFIKAVAWRFEDSGLGVILPPSLANREGWANRLG 455
Nostoc_SNF2                   DTESPQFCHLKPMQAYEFIKAVAWRFEDSGLGVILPPSLANREGWANRLG 452
Nodsp_SNF2                    ETEYPQCCRLNPLQAYEFIKSVAWRFEDSGLGVILPPSLTNREGWANRLG 472
Lyn_sp_SNF2                   QEARPQTCLLTPLQAYEFIKSINWRFTDSGLGVILPPSLVSQNGWANRLG 435
Crowa_SNF2                    QDNKPSFSELDPIQVYEFLRSIANILKDNGLGVILPASLEQG-VEEKRLG 432
Synel_PCC6301_SNF2            ATACPEFHPLTTAEVYQLLKQVIPQWQEQGIEVQLPPGLR-GQGRHR-LG 396
Synel_PCC7942_SNF2            ATACPEFHPLTTAEVYQLLKQVIPQWQEQGIEVQLPPGLR-GQGRHR-LG 396
Theel_BP-1_SNF2               QERSPVALTLHTTEVYAFLQSAIAPLEQQGVAIILPPSLRRNSAQHR-LG 388
Glovi_SNF2                    LVPQPTCCTMSTVEAFQFLKAATWRLRDSGFGVLLPESLADAGSLRNRLG 392
Proma_CCMP1375_SNF2           ESPTPHTMKLSASEAFVLIRTAAAKLRDMGIGVILPNSLSKG--FASRLG 447
Proma_MIT\9211_SNF2           ENATPNNMQLTPAEAFVLVRTASKQLRDIGIGVILPRSLSGG--LASRLG 454
Proma_MIT\9303_SNF2           DSATPEAMQLTPAEAFVLVRTAAAQLRDVGVGVELPASLSGG--LASRLG 487
Proma_MIT9313_SNF2            DSATPEAMQLTPAEAFVLVRTAATQLRDVGVGVELPASLSGG--LASRLG 487
Syn_sp_CC9311_SNF2            DSATPESMQLTPAEAFVLVRTAVRQLRDVGVGVDLPPSLSGG--LASRLG 450
Syn_sp_WH\7805_SNF2           DSATPEAMQLTPAEAFVLVRTAARQLRDVGVGVDLPPSLSGG--LASRLG 453
Syn_sp_RS9916_SNF2            DSATPEGMQLTPAEAFVLVRTAARELRDVGVGVELPASLSGG--LASRLG 448
Syn_sp_CC9605_SNF2            ESATPETMQLTPAEAFVLVRTAARQLRDAGVGVELPPSLSGG--LASRLG 451
Syn_sp_WH\8102_SNF2           ETATPDTMQLTPAEAFVLVRTAARQLRDAGVGVDLPPSLSGG--LASRLG 451
Syn_sp_CC9902_SNF2            ESATPETMQLTPAEAFVLVRTATHQLRNAGIGVELPPSLSGG--LASRLG 451
Syn_sp_\WH\5701_SNF2          DTATPERMALTPAEAFVLVRTAALKLRDVGVGVVLPPSLSGG--LASRLG 426
Myctu_SNF2                    RTACPSGLELDADGAYRFLSGTAAVLDEAGFGVLLPSWW---DRRR-KLG 394
Mycbo_SNF2                    RTACPSGLELDADGAYRFLSGTAAVLDEAGFGVLLPSWW---DRRR-KLG 394
Nocfa_IFM\10152_SNF2          GDPHSLDLLLPTEVVADLVAHGAQALREAGVRLLLPRAW---TIAEPTLR 349
Myxxa_DK_SNF2                 ESPRPQALLLEPDTAWTFLSEGARVLSDAGFGVIVPGELTTSGRRRLRLR 454
Symth_IAM14863_SNF2           RDPAPSRMRIPADDVLALIQEGAMLLQQAGHPVLLPAALAKP--AALRVG 397
Metac_C2A_SNF2                EAPNPSGYSLDTKEAYRFLTESAADLSQAGFGLLLPGWWTRK-GTKTHLK 447
Metma_Go1_SNF2                EAPNPSGYSLDTKEAYRFLTESAANLSQAGFGVLLPGWWTRK-GTKTHLK 453
Pelph_BU-1_SNF2               KKKQPGGFDLDTEGAYRFLLEYAELLRSAGFVVKLPSWWIGR-RGVNRIG 395
Archaeon\RC-I_SNF2            NTSKPLSATLSTSEAYKFLTEAAPLLQDSGYSIILPEWWRNS-TGRLKLG 426
Nos_sp_PCC7120_SNF2\II        ETDSPTGMQLSLDEAFDFLKDSAWVLEDSGFKVIVPAWYTPAGRRRAKIR 442
Bacce_ATCC10987_SNF2          KDGDTFRSELFETEAWNFLTEASNELLAAGITILLPSWWQNLKATKPKLR 311
Methu_JF-1_SNF2               SGSKPTGGSMTLKEAATFLGSDLARARRKGVTVLLPDWWTDTTYTPRVEI 438
                                  .    :    .  ::          *  : :*
```

FIGURE 8 (continued)

```
Synco_SNF2                    VKVVGEVQRQ----RGQR-LTLQSLINYDLQLMMGSGDNARLLTAKDFEA 462
Anava_SNF2                    LKISAETPKK----KPGR-LGLQSLLNFQWHLAIG----GQTISKGEFDR 496
Nostoc_SNF2                   LKISAETPKK----KPGR-LGLQSLLNFQWHLAIG----GQTISKAEFDR 493
Nodsp_SNF2                    LKISAETQKK----KQGR-LGLQSLLNFQWQLAIG----GQTISKTEFNK 513
Lyn_sp_SNF2                   LSVQAATSKS----KQNVSLGLDSLLNFKWELSIG----GQTLSKTEFNR 477
Crowa_SNF2                    ISLTAEVKSK----KGQR-LSLQSLLSYKLNLAIG----DKTISKKDFEK 473
Synel_PCC6301_SNF2            VEVSATLPSD----RPS--VGLEALLQFRWELSLG----GQRLTKAEVER 436
Synel_PCC7942_SNF2            VEVSATLPSD----RPS--VGLEALLQFRWELSLG----GQRLTKAEVER 436
Theel_BP-1_SNF2               LKIIATLPPP----ATNG-LTIDSLMQFQWQLQLG----QHPLSEADFDQ 429
Glovi_SNF2                    LKLEANAPGR----NGSG-LGMQSLLAFKWELSLA----GKTLSRAEFDR 433
Proma_CCMP1375_SNF2           LAIQAELPES----SLG--VMLGESLNWDWELMIG----GINLSMKELEM 487
Proma_MIT\9211_SNF2           IAIKAELATS----ARG--LTLRENLEWSWELMIG----GSILSLKDLEQ 494
Proma_MIT\9303_SNF2           LAIKAELSER----SRG--FTLGETLDWSWELMIG----GVTLTLRELER 527
Proma_MIT9313_SNF2            LAIKAELSER----SRG--FTLGETLDWSWELMIG----GVTLTLRELER 527
Syn_sp_CC9311_SNF2            LAIKAELSER----SRG--FTLGENLDWSWELMIG----GVTLTLRELER 490
Syn_sp_WH\7805_SNF2           LAIKAELPKR----SRG--FTLGENLDWNWELMIG----GVTLTLRELER 493
Syn_sp_RS9916_SNF2            LAIQAELPEK----SRG--FTLGETLDWSWELMIG----GVTLTLRELER 488
Syn_sp_CC9605_SNF2            LSIKAELPER----SSG--FTLGECLAWEWDLMIG----GVTLTLRELER 491
Syn_sp_WH\8102_SNF2           LAIKAELPER----SSG--FSLGESLDWSWDLMIG----GVTLTLRELER 491
Syn_sp_CC9902_SNF2            LAIKADLPDR----SSG--FTLGESLDWSWDLMIG----GVTLTLRELER 491
Syn_sp_\WH\5701_SNF2          LSIEADLPER----SRG--FSLGESLQWSWELMIG----GVTLTLRDLER 466
Myctu_SNF2                    LVLSAYTPVDGVV-GKASKFGREQLVEFRWELAVG----DDPLSEEEIAA 439
Mycbo_SNF2                    LVLSAYTPVDGVV-GKASKFGREQLVEFRWELAVG----DDPLSEEEIAA 439
Nocfa_IFM\10152_SNF2          LAVSSAAPAA------ESTVGMQGLLSYRWELAVG----DKVLTRAEMER 389
Myxxa_DK_SNF2                 MRVGASTKAAGAV-GGTAGLGLDALLRVDWDAVLG----DQPLSAQELAL 499
Symth_IAM14863_SNF2           MRLSP------AG-GSPSMFGLHQIVNVRWDVALG----GTPLTLDELRH 436
Metac_C2A_SNF2                AQANVKGKK-LKA-GYG--LTLDKIVSFDWEIALG----DRALTVRELQA 489
Metma_Go1_SNF2                AQANVKGKKKLQA-GYG--LTLDEIVSFDWEIALG----DRVLTVRELQA 496
Pelph_BU-1_SNF2               IKTKVKLPSMKGS-GSG--LTLDRMVACDYAAALG----NEELDLQELKT 438
Archaeon\RC-I_SNF2            ARLRFKPKAEGKA-GKSQ-FTMDTLVSYDWRLALG----DQEITETEFRK 470
Nos_sp_PCC7120_SNF2\II        LKASSGRKVAATVGESKSYFGLDSLVQYQYELAIG----EQTLTPQEWEQ 488
Bacce_ATCC10987_SNF2          VQLKQNATQT------QSFFGMNTLVNFDWRISTN----GIDLSESEFFE 351
Methu_JF-1_SNF2               HARRRDPTHT------QTRIGLQELLSFDYRIAIG----DESFSPDEFWE 478
                                                .     :                :    :
```

FIGURE 8 (continued)

```
Synco_SNF2                    LLAQKSPLVVLDGEWITLQPADVRAAKVILQQQQS-APPLTVEDALRLSI 511
Anava_SNF2                    LVALKSPLVEINGEWVELRPQDIKTAEAFFAARKD-QMALSLEDALRLSS 545
Nostoc_SNF2                   LVALKSPLVEINGEWVELRPQDIKTAEAFFTARKD-QMALSLEDALRLSS 542
Nodsp_SNF2                    LVALNSPLVEINGEWVELRPQDIKTAQTFFASRKD-EMTLSLEDALRLSS 562
Lyn_sp_SNF2                   LVAQESPLVEINGEWVELRPTDIKAAKAFFSSRKD-QLSLTLEDALRLST 526
Crowa_SNF2                    LLAQKSPLVEVKGEWIALQPADVKAAQQILNKSYD-PLELSVEDALRFST 522
Synel_PCC6301_SNF2            LAALETPLVEINGDWIEVRPQDIESAREFFRKRKD-QPNLTLADAIAIAS 485
Synel_PCC7942_SNF2            LAALETPLVEINGDWIEVRPQDIESAREFFRKRKD-QPNLTLADAIAIAS 485
Theel_BP-1_SNF2               LRRQGTPLVYLNGEWVLLRPQEVKAAQEFLQS-PP-KTQLSLAETLRIAT 477
Glovi_SNF2                    LAASSEPLVKVNDNWVELRPQDVRAAHSFLQSRKD-QVGLSLEDVLRLNF 482
Proma_CCMP1375_SNF2           LAKKNSPLLNHKGTWIELRPNDLKNASKFFAN----TPELNLDKALRLSA 533
Proma_MIT\9211_SNF2           LASKRSPLVRYKDSWLELRPNDLKIAEKFCSN----NPELSLDDALRLTA 540
Proma_MIT\9303_SNF2           LASKRSPLVNHKGAWIELRPNDLKNAEHFCSV----NPGISLDDALRLTA 573
Proma_MIT9313_SNF2            LASKRSPLVNHKGAWIELRPNDLKHAEHFCSV----NPGISLDDALRLTA 573
Syn_sp_CC9311_SNF2            LAGKRSPLVRHKGAWIELRPNDLKNAERFCAA----NPDLSLDDALRLTA 536
Syn_sp_WH\7805_SNF2           LAGKRSPLVRHKGAWIELRPNDLKNAERFCAA----NPDLSLDDALRLTA 539
Syn_sp_RS9916_SNF2            LAGKRSPLVRHKGTWIELRPNDLKNAERFFAA----KPDLSLDDALRLTA 534
Syn_sp_CC9605_SNF2            LSGKRSPLVRHKGAWIELRPNDLKNAERFCGA----KPELSLDDALRLTG 537
Syn_sp_WH\8102_SNF2           LSGKRSPLVRHKGAWIELRPNDLRNAERFCGA----NPELSLDDALRITA 537
Syn_sp_CC9902_SNF2            LSGKRSPLVRHKGAWIELRPNDLRNAERFCGA----NPELSLDDALRLTA 537
Syn_sp_\WH\5701_SNF2          LAGKRSPLVQHKGAWIELRPGDLRNAEKFCAL----DPVLSLDDALRLTG 512
Myctu_SNF2                    LTETKSPLIRLRGQWVALDTEQMRRGLEFLERKP--TGRKTTAEIL-ALA 486
Mycbo_SNF2                    LTETKSPLIRLRGQWVALDTEQLRRGLEFLERKP--TGRKTTAEIL-ALA 486
Nocfa_IFM\10152_SNF2          LVRAKSDLVQLRGEWVQADHKVLAAAARYVAAHLD-TSPVTLADLLGEIA 438
Myxxa_DK_SNF2                 LAQRKAPLVRFRGEWVAVDPLELDAIQRHLAQGPG-RMALSEAVRVSLLG 548
Symth_IAM14863_SNF2           LARQKRPLVQMQGRWVRVDERTLAAVLRRIEQHGG-QMELGTALRLAPEA 485
Metac_C2A_SNF2                LAKLKAPLVKFRGQWVEVNDAEIRAALEFWKKNP--HGEASLREVLKLAV 537
Metma_Go1_SNF2                LAKLKAPLVKFRGQWVEVNDAEIRAALEFWKKNP--NGEASLREVLKLAV 544
Pelph_BU-1_SNF2               LANLKVPLVRVRGQWTQIDHKELANALHFLEKHP--TGELSARELLSTAL 486
Archaeon\RC-I_SNF2            LAALKEPLLQIGGKWFALKKEDIDSIMKAFRAKK--TGEMALSEALRLNG 518
Nos_sp_PCC7120_SNF2\II        LINTKAPLVHFRGQWMELDRDKMQQLLEFWQSHGDEQPQMSLLEFMQRSA 538
Bacce_ATCC10987_SNF2          LVEQNKRLFNINGQWMRLDPAFIEEVRKLMNRAD-KYG-LEMKDVLQQHL 399
Methu_JF-1_SNF2               KVKEKAPFIWLGNRWISFHPDAIQHALDSFSRHQ-SKGGDTIGDLLRLSL 527
                                     :.   . *       :                     :
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FIGURE 8 (continued)

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Synco_SNF2                    GDLQTVSKLP------VTQFAARGILQELIDTLRNPEGVKAIADPPGFQG 555
Anava_SNF2                    GDTQVIEKLP------VVSFEASGALQELIGALTNNQAVAPLPTPKNFQG 589
Nostoc_SNF2                   GDTQVIEKLP------VVSFEASGALQELIGALTNNQAVAPLPTPKNFQG 586
Nodsp_SNF2                    GDTQAIEKLP------VVSFEASGTLQELIGALTNNQAISPLPTPANFQG 606
Lyn_sp_SNF2                   GDSQMVEKLP------IVNFEAGGKLEELLNTLTNNRSLDEIKTPSNFQG 570
Crowa_SNF2                    GDISTVAKLP------ITNFEAKGELANLINAINNNESIPMIENPRGFKG 566
Synel_PCC6301_SNF2            GESPNVGRLP------VVNFEAAGLLEEALAVFQGQRSPAALPAPPTFQG 529
Synel_PCC7942_SNF2            GESPNVGRLP------VVNFEAAGLLEEALAVFQGQRSPAALPAPPTFQG 529
Theel_BP-1_SNF2               GDTVTVAKLP------ILGLDTNDALQTLLDGLTGKQSLDPVPTPQEFCG 521
Glovi_SNF2                    GDTPKIDGLP------IVNFDSSGPIQQLLETLTDQRKLTPIDEPPGFKG 526
Proma_CCMP1375_SNF2           NKGNTFMKLP------VHHFESGPRLQSVLEQYHHQKAPEPLPAPNGFHG 577
Proma_MIT\9211_SNF2           TKGETLMKLP------VHQFNAGPKLQGVLEQYHQHTSPEPLAAPDGFYG 584
Proma_MIT\9303_SNF2           TDGDTLMRLP------VHRFEAGPRLQAVLEQYHQQKAPDPLPAPEGFCG 617
Proma_MIT9313_SNF2            TDGDTLMRLP------VHRFEAGPRLQAVLEQYHQQKAPDPLPAPEGFCG 617
Syn_sp_CC9311_SNF2            TEGDTMMRLP------VHQFDAGPRLQAVLEQYHQQKAPDPLPAPEGFSG 580
Syn_sp_WH\7805_SNF2           SEGDTLMRLP------VHAFDAGPRLQGVLEQYHQQKAPDPLPAPEGFCG 583
Syn_sp_RS9916_SNF2            SEGDTLMRMP------VHRLEAGPRLQAVLEQYHQQKAPDPLPAPEGFCG 578
Syn_sp_CC9605_SNF2            TEGELLMRMP------VHRFDAGPRLQSVLQQYHQQKAPDPLPAPEGFSG 581
Syn_sp_WH\8102_SNF2           TEGDLLMRLP------VHRFEAGPRLQAVLEQYHQQKAPDPLPAPEGFCG 581
Syn_sp_CC9902_SNF2            TEGELMMRLP------VHRFDAGPRLQGVLEQYHQQKAPDPLPAPEGFSG 581
Syn_sp_\WH\5701_SNF2          NEGETLQRLP------VHRFTAGPRLKAVLEQYHQQKAPDPLPAPEGFAG 556
Myctu_SNF2                    ASHPDDVDTPLE----VTAVRADGWLGDLLAGAAA-ASLQPLDPPDGFTA 531
Mycbo_SNF2                    ASHPDDVDTPLE----VTAVRADGWLGDLLAGAAA-ASLQPLDPPDGFTA 531
Nocfa_IFM\10152_SNF2          ATRVDKVP--------LTEVTATGWAGELFDGGR-----EPVATPGGLKA 475
Myxxa_DK_SNF2                 ETRHGQLP---------VTVLATGALEERLRLLRE-GGATAQDAPRALRA 588
Symth_IAM14863_SNF2           DEAT-----------------ATGWIAELLERLQEPARMEPVPTPGGFAG 518
Metac_C2A_SNF2                GVSEKADGVD------VEGLNAAGWIEELIRRLKDKTGFEELPAPDGFSG 581
Metma_Go1_SNF2                GVSEKADGVN------VEGLNATGWIGELISRLKDKTGFEELPAPNGFSG 588
Pelph_BU-1_SNF2               GAQKKEDALF------LRSVEIEGWLQELLEKLSSQGQFELLPPPEHFEG 530
Archaeon\RC-I_SNF2            GLEDFN-GIP------VSGMKSSGWLAELFDRLAAGEKITSLAPPDGFNG 561
Nos_sp_PCC7120_SNF2\II        QGEDD------------WEIEYDAALSEIMAKLQDKSQLEPISEDLNLQG 576
Bacce_ATCC10987_SNF2          SNTAETEIVEEDSPFTDIEIELDGYYEDLFQKLLHIGDIPKVDVPSSLNA 449
Methu_JF-1_SNF2               KKMEDSAVP--------VSIHAKDDWVADLLDFFRTETNQAVPVPKKFKG 569
                                                             :                : .
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FIGURE 8 (continued)

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Synco_SNF2                  TLRPYQARGVGWLAFLERWGLGACLADDMGLGKTPQLLAFLLHLAAEDML 605
Anava_SNF2                  KLRPYQERGAAWLAFLERWGLGACLADDMGLGKTIQFIAFLLHLKEQDVL 639
Nostoc_SNF2                 QLRPYQERGAAWLAFLERWGLGACLADDMGLGKTIQFIAFLLHLKEQDVL 636
Nodsp_SNF2                  QLRPYQERGAAWLAFLERWGLGACLADDMGLGKTIQLIAFLLHLKEQDAL 656
Lyn_sp_SNF2                 ELRPYQARGVSWLAFLEEWGLGACLADDMGLGKTIELIAFLLYLQEKETL 620
Crowa_SNF2                  QLRPYQQRGVGWLSFLEKWGLGACLADDMGLGKTPQLIGFLLHLRSEGML 616
Synel_PCC6301_SNF2          ELRPYQERGVGWLSFLQRFGIGACLADDMGLGKTIQLLAFLLHLKHSNEL 579
Synel_PCC7942_SNF2          ELRPYQERGVGWLSFLQRFGIGACLADDMGLGKTIQLLAFLLHLKHSNEL 579
Theel_BP-1_SNF2             ELRPYQARGVAWLSFLERWRLGACLADDMGLGKTIQLLAFLLHLKETGRA 571
Glovi_SNF2                  TLRPYQKIGVGWLAFLQKWGLGACLADDMGLGKTVELIAFLLFLKSKNEL 576
Proma_CCMP1375_SNF2         QLRPYQERGLGWLAFLYRFKQGACLADDMGLGKTIQLLCFIQHLKVQNEL 627
Proma_MIT\9211_SNF2         QLRPYQERGIGWLAFLHRFNQGACLADDMGLGKTIQVLAFIQHLKSNKDL 634
Proma_MIT\9303_SNF2         QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEQEL 667
Proma_MIT9313_SNF2          QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEQEL 667
Syn_sp_CC9311_SNF2          QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAENEL 630
Syn_sp_WH\7805_SNF2         QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKMEQEL 633
Syn_sp_RS9916_SNF2          QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEQEL 628
Syn_sp_CC9605_SNF2          QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEQEL 631
Syn_sp_WH\8102_SNF2         QLRPYQERGLGWLAFLNRFDQGACLADDMGLGKTIQLLAFLQHLKAEQEL 631
Syn_sp_CC9902_SNF2          QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEHEL 631
Syn_sp_\WH\5701_SNF2        QLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEQEL 606
Myctu_SNF2                  TLRPYQQRGLAWLAFLSSLGLGSCLADDMGLGKTVQLLALETLESVQRHQ 581
Mycbo_SNF2                  TLRPYQQRGLAWLAFLSSLGLGSCLADDMGLGKTVQLLALETLESVQRHQ 581
Nocfa_IFM\10152_SNF2        QLRPYQLRGLSWLATMSRMGCGGILADDMGLGKTVQVLALLVHERETSTA 525
Myxxa_DK_SNF2               TLRPYQSRGLHWLDTLASLGLGACLADDMGLGKTVQVLAFLLRRLEQAPD 638
Symth_IAM14863_SNF2         TLRPYQQRGLAWLAFLRRWGLGACLADDMGLGKTVQLIALLLHEREAG-W 567
Metac_C2A_SNF2              TLRPYQFRGYSWLAFLRQWGIGACLADDMGLGKTIQTLALIQHDLEQVKG 631
Metma_Go1_SNF2              TLRPYQFRGYSWLAFLRQWGIGACLADDMGLGKTVQTLALIQHDLEQAKE 638
Pelph_BU-1_SNF2             TLRLYQERGFSWLSFLRKWGLGACLADDMGLGKTIQTLALLQRERE---- 576
Archaeon\RC-I_SNF2          ELRDYQVKGYSWLAFMKKYGLGSILADDMGLGKTIQLLALLLKEKE---- 607
Nos_sp_PCC7120_SNF2\II      NLREYQKRGVAWLQYLEKLGLNGCLADDMGLGKSVQVIARLVQEKDSQSS 626
Bacce_ATCC10987_SNF2        TLRPYQQHGIEWLLYLRKLGFGALLADDMGLGKSIQTITYLLYIKENNLQ 499
Methu_JF-1_SNF2             ILRPYQEEGFSFLCQCTRRGFGACLADDMGLGKTPQTLAWLVYLKEKEKP 619
                             ** **  *  :*       .. *********: : :
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FIGURE 8 (continued)

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Synco_SNF2                  VK----------------------PVLIVCPTSVLSNWGHEINKFAPQL 632
Anava_SNF2                  EK----------------------PTLLVCPTSVLGNWEREVKKFAPTL 666
Nostoc_SNF2                 EK----------------------PTLLVCPTSVLGNWEREVRKFAPTL 663
Nodsp_SNF2                  EN----------------------PTLLVCPTSILGNWEREIKKFAPTL 683
Lyn_sp_SNF2                 DA----------------------PVLLVCPTSVLGNWEREVKRFSPSL 647
Crowa_SNF2                  DQ----------------------PTLVICPTSVLNNWEREVQKFAPTL 643
Synel_PCC6301_SNF2          TR----------------------PVLLVCPTSVLGNWEREVQKFAPEL 606
Synel_PCC7942_SNF2          TR----------------------PVLLVCPTSVLGNWEREVQKFAPEL 606
Theel_BP-1_SNF2             YR----------------------PTLLICPTSVLGNWLRECQKFAPTL 598
Glovi_SNF2                  DG----------------------PILLICPTSVMGNWEREIKKFSPSL 603
Proma_CCMP1375_SNF2         TK----------------------PVLLIAPTSVLTNWKREAATFTPEL 654
Proma_MIT\9211_SNF2         KK----------------------PVLLIAPTSVLTNWKREAYSFTPEL 661
Proma_MIT\9303_SNF2         KR----------------------PVLLIAPTSVLTNWKREALAFTPEL 694
Proma_MIT9313_SNF2          KR----------------------PVLLIAPTSVLTNWKREALAFTPEL 694
Syn_sp_CC9311_SNF2          KR----------------------SVLLIAPTSVLTNWKREATAFTPEL 657
Syn_sp_WH\7805_SNF2         KR----------------------PVLLVAPTSVLTNWKREAAAFTPEL 660
Syn_sp_RS9916_SNF2          KR----------------------PVLLVAPTSVLTNWKREAAAFTPEL 655
Syn_sp_CC9605_SNF2          KR----------------------PVLLVAPTSVLTNWRREAESFTPEL 658
Syn_sp_WH\8102_SNF2         KR----------------------PVLLVAPTSVLTNWRREAEAFTPEL 658
Syn_sp_CC9902_SNF2          KR----------------------PVLLVAPTSVLTNWRREAEAFTPEL 658
Syn_sp_\WH\5701_SNF2        KR----------------------PVLLVAPTSVLTNWLREAKAFTPEL 633
Myctu_SNF2                  DRGV--------------------GPTLLLCPMSLVGNWPQEAARFAPNL 611
Mycbo_SNF2                  DRGV--------------------GPTLLLCPMSLVGNWQQEAARFAPNL 611
Nocfa_IFM\10152_SNF2        PP----------------------GPTLLVCPMSVVGNWQREAQRFAPGL 553
Myxxa_DK_SNF2               EAR---------------------PTLLVAPTSVVGNWERELARFAPTL 666
Symth_IAM14863_SNF2         AAG---------------------PTLLVCPVSVLGNWCRELARFAPGL 595
Metac_C2A_SNF2              QVEEKVIENAEEKVEG----LKAAKPVLLVCPTSVINNWKKEAARFTPEL 677
Metma_Go1_SNF2              KAEEKIEEPAEEKIEEKVDGRKAPKPVLLVCPTSVINNWKKEASRFTPEL 688
Pelph_BU-1_SNF2             -------------------LGEKRAVLLICPTSVVNNWRKEAERFTPDL 606
Archaeon\RC-I_SNF2          -------------------RGTKGPTLLICPTSILGNWQREAKKFAPAL 637
Nos_sp_PCC7120_SNF2\II      PL----------------------PTLLIAPTSVVGNWQREIAKFAPHL 653
Bacce_ATCC10987_SNF2        TG----------------------PALIVAPTSVLGNWQKEFERFAPNL 526
Methu_JF-1_SNF2             TT----------------------PSLLICPMSVVGNWEREIQRFAPSL 646
                                                     . *:::.* *:: ** :*   *:* *
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FIGURE 8 (continued)

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Synco_SNF2                  KTLLHHGDRRK-KGQPLVKQVKDQQIVLTSYALLQRDFSSLKLVDWQGIV 681
Anava_SNF2                  KVLQYHGDKRP-KGKAFPEAVKNHDLVITSYSLIHRDIKSLQGLSWQIIV 715
Nostoc_SNF2                 KVLQYHGDKRP-KGKAFQEAVKKHDLVITSYSLIHRDIKSLQGIPWQIIV 712
Nodsp_SNF2                  KVLQHHGDKRL-KGKAFVEAVKKHDVIITSYSLVHRDIKSLQSVDWQTVV 732
Lyn_sp_SNF2                 KVTVHHGDKRQ-KGKNFAQFAQKYNLIITSYPLTFRDEKELKTVNWKGLV 696
Crowa_SNF2                  STLIHHGDKRS-KGKAFVKAVSKKNVIITSYSLIYRDIKSFEQVEWQGIV 692
Synel_PCC6301_SNF2          RWKLHYGPDRA-QGKALATALKDCDLVLTSYSLVARDQKAIAAIDWQGIV 655
Synel_PCC7942_SNF2          RWKLHYGPDRA-QGKALATALKDCDLVLTSYSLVARDQKAIAAIDWQGIV 655
Theel_BP-1_SNF2             RAYVHHGSDRP-KGKAFLKKVETHDLILTSYALLQRDRTTLQQVLWQHLV 647
Glovi_SNF2                  SVHVHHGARRP-KGRNFVETAQKKQIIVSSYALVQRDSKDLKRVEWLGLV 652
Proma_CCMP1375_SNF2         CIHEHYGSKRHSSIPKLQNYLKKVDIMITSYGLLYRDGELLQEIDWQGIV 704
Proma_MIT\9211_SNF2         SVLEHYGPNRSSTSTLLKKILKKVDILITSYGLLHRDKQLLKTIDWQGVI 711
Proma_MIT\9303_SNF2         NVREHYGPRRPSTPAALKKALKGLDLVLTSYGLLQRDSELLETVDWQGVV 744
Proma_MIT9313_SNF2          NVREHYGPRRPSTPAALKKALKGLDLVLTSYGLLQRDSELLETVDWQGVV 744
Syn_sp_CC9311_SNF2          KVHEHYGPKRPSTPAALKKALKDVDLVLTSYGLLQRDSELLESHDWQGLV 707
Syn_sp_WH\7805_SNF2         TVHEHYGPKRPSTPAALKKALKDVDLVLTSYGLLQRDSELLESFDWQGTV 710
Syn_sp_RS9916_SNF2          EVKEHYGPRRPATPAALKKSLKDVDLVLTSYGLLQRDSELLESLDWQGVV 705
Syn_sp_CC9605_SNF2          KVTEHYGPRRPSTPAELKKALKEVDLVLTSYGLLQRDSELLETQDWQGVV 708
Syn_sp_WH\8102_SNF2         AVREHYGPRRPSTPAALKKALKDVDLVLTSYGLLQRDSELLESQDWQGVV 708
Syn_sp_CC9902_SNF2          SVKEHYGPRRPSTPAALKKELKDVDLVLTSYGLMQRDSELLDSVDWQGVV 708
Syn_sp_\WH\5701_SNF2        NVVEHYGPRRPSTPAALKKKLEGMDLVLTSYGLLQRDSELLSSLDWQGVV 683
Myctu_SNF2                  RVYAHHGGARLHGEALRDHLERT-DLVVSTYTTATRDIDELAEYEWNRVV 660
Mycbo_SNF2                  RVYAHHGGARLHGEALRDHLERT-DLVVSTYTTATRDIDELSEYEWNRVV 660
Nocfa_IFM\10152_SNF2        RVLVHHGADRRRDAELDAAVADS-DLVLTTYAILARDAAELSRQSWDRVV 602
Myxxa_DK_SNF2               RLTRHYGAERARAANRFPRAPGA--VVLTTYGLLRRDAALLARVDWGAVV 714
Symth_IAM14863_SNF2         RVLVHHGPGRLGEPD-FARQAGAHDVVLTTYSLLARDAALLGQVTWNGIV 644
Metac_C2A_SNF2              SVMVHHGTSRK-KEEEFKKEATNHSIVVSSYGLLQRDLKFLKGVSWAGVV 726
Metma_Go1_SNF2              SVMVHHGTSRK-KEEEFKKEAMNHAIVISSYGLVQRDLKFLKEVHWAGVV 737
Pelph_BU-1_SNF2             AVLVHHGIDRM-KTADFRKAASASALVISSYGLLQRDLEFLSKVPWAGII 655
Archaeon\RC-I_SNF2          KVHIHHGAGRA-DKEQFGKIVKAHDLILSTYAHAYRDEELLKEVNWKLVV 686
Nos_sp_PCC7120_SNF2\II      KTMVHHGSDRLQDAAEFKSACQQHDVVISSFTLARLDEKLLNSVTWQRLV 703
Bacce_ATCC10987_SNF2        RVQLHYGSNRA-KGEPFKDFLQSADVVLTSYALAQLDEEELSTLCWDAVI 575
Methu_JF-1_SNF2             RSWVHHGTDRC-KGDDFVRHVGSYDLVLTTYHLAARDVDHLKTVPWSAII 695
                                ::*  *               ::::::     *   :    *   :
```

FIGURE 8 (continued)

```
Synco_SNF2                  LDEAQNIKNPQAKQSQAARQLP-------AGFRIALTGTPVENRLTELWS 724
Anava_SNF2                  LDEAQNVKNAEAKQSQAVRQLD-------TTFRIALTGTPVENRLQELWS 758
Nostoc_SNF2                 LDEAQNVKNAEAKQSQAVRQLE-------TTFRIALTGTPVENRLQELWS 755
Nodsp_SNF2                  LDEAQNVKNPEAKQSQAVRGLK-------TTFRIALTGTPVENKLQELWS 775
Lyn_sp_SNF2                 LDEAQNIKNPEAKQSKTVRNLQ-------ASFKIALTGTPVENRLSELWS 739
Crowa_SNF2                  LDEAQNIKNPQAKQSQAVRQIS-------TQFRIALTGTPVENRLTELWS 735
Synel_PCC6301_SNF2          LDEAQNIKNDQAKQTQAVRAIAQSP-TQKPRFRIALTGTPVENRLSELWS 704
Synel_PCC7942_SNF2          LDEAQNIKNDQAKQTQAVRAIAQSP-TQKPRFRIALTGTPVENRLSELWS 704
Theel_BP-1_SNF2             LDEAQNIKNANTQQSQAARELS-------AQFRIALTGTPLENRLLELWS 690
Glovi_SNF2                  LDEAQNIKNPDAKQTQSIRELT-------ARFRIALTGTPVENRLAELWS 695
Proma_CCMP1375_SNF2         IDEAQAIKNSKSKQSIITRAISKNL--ISNPFRIALTGTPVENRISELWA 752
Proma_MIT\9211_SNF2         IDEAQAIKNPNSKQSQTTREIVKGG--KIIPFRIALTGTPIENRVSELWS 759
Proma_MIT\9303_SNF2         IDEAQAIKNPNAKQSQAARDMGRPD--KNNRFRIALTGTPVENRVSELWA 792
Proma_MIT9313_SNF2          IDEAQAIKNPNAKQSQAARDMGRPD--KNNRFRIALTGTPVENRVSELWA 792
Syn_sp_CC9311_SNF2          IDEAQAIKNPSAKQSQAARDLARPK--KNSRFRIALTGTPVENRVSELWA 755
Syn_sp_WH\7805_SNF2         IDEAQAIKNPSAKQSQAARDLARTR--KGSRFRIALTGTPVENRVSELWA 758
Syn_sp_RS9916_SNF2          IDEAQAIKNPSAKQSMAARDLARAG--RSSRFRIALTGTPVENRVSELWA 753
Syn_sp_CC9605_SNF2          IDEAQAIKNPGAKQSQAARDLARTGRIKSNRFRIALTGTPVENRVSELWA 758
Syn_sp_WH\8102_SNF2         IDEAQAIKNPSAKQSQAARDLARP--AKGNRFRIALTGTPVENRVSELWA 756
Syn_sp_CC9902_SNF2          IDEAQAIKNPGAKQSQAARDLARAG--KSSRFRIALTGTPVENRVSELWA 756
Syn_sp_\WH\5701_SNF2        IDEAQAIKNSSARQSQAARDLARPL--KQSRFRIALTGTPVENRVSELWA 731
Myctu_SNF2                  LDEAQAVKNSLSRAAKAVRRLR-------AAHRVALTGTPMENRLAELWS 703
Mycbo_SNF2                  LDEAQAVKNSLSRAAKAVRRLR-------AAHRVALTGTPMENRLAELWS 703
Nocfa_IFM\10152_SNF2        LDEAQHIKNAATRQARAARALP-------ARHRLALTGTPVENRLEELRS 645
Myxxa_DK_SNF2               LDEAQNIKNAASATARAARALR-------ASQRFALTGTPVENRLAELWS 757
Symth_IAM14863_SNF2         ADEAQNLKNPDTQHARALRSLS-------GGYRIALTGTPVENHLGDLWS 687
Metac_C2A_SNF2              LDEAQNIKNPETKQAKAARALE-------ADYRIALTGTPVENNVGDLWS 769
Metma_Go1_SNF2              LDEAQNIKNPETKQAKAARALE-------SDYRLALTGTPVENNVGDLWS 780
Pelph_BU-1_SNF2             LDEAQNIKNPETKQSKAARTIR-------ADYRIALTGTPVENHVGDLWA 698
Archaeon\RC-I_SNF2          LDEAQNIKNHHTRQARAIRALK-------ADHRIAMTGTPIENRLSELWS 729
Nos_sp_PCC7120_SNF2\II      LDEAQNIKNPKAAQTKAILKLS-------AKHRLALTGTPVENRLLDLWS 746
Bacce_ATCC10987_SNF2        LDEAQNIKNPHTKQSKAVRNLQ-------ANHKIALTGTPMENRLAELWS 618
Methu_JF-1_SNF2             LDEAQNIKNLHANQTVAVKSLT-------GERRVALTGTPVENRLLELWS 738
                             **** :**   :  :     :           :.*:****:**.: :* :
                            Motif II                      Motif III
```

FIGURE 8 (continued)

```
Synco_SNF2                    ILEFLNPGFLGNQSFFQRRFANPIEKFGDRQSLLILRNLVRPFILRRLKT 774
Anava_SNF2                    ILDFLNPGYLGNKQFFQRRFAMPIEKYGDAASLNQLRALVQPFILRRLKT 808
Nostoc_SNF2                   ILDFLNPGYLGNKQFFQRRFAMPIEKYGDAASLNQLRALVQPFILRRLKT 805
Nodsp_SNF2                    ILDFLNPGYLGNRQFFQRRFAMPIEKYGDTASLNQLRGLVQPFILRRLKT 825
Lyn_sp_SNF2                   IMDFLNPGYLGQRQFFQRRFAIPIEKYGDTDSLKTLRSLVQPFILRRLKT 789
Crowa_SNF2                    ILDFLNPGFLGTQQFFRRRFATPIEKYGDKESLQIMRSLVRPFILRRLKT 785
Synel_PCC6301_SNF2            IVEFLQPGHLGTKPFFQKRFVTPIERFGDADSLTALRQRVQPLILRRLKT 754
Synel_PCC7942_SNF2            IVEFLQPGHLGTKPFFQKRFVTPIERFGDADSLTALRQRVQPLILRRLKT 754
Theel_BP-1_SNF2               IMDFLHPGYLGHRTYFQHRYVRPIERYGDTTSLNALRTYVQPFILRRLKT 740
Glovi_SNF2                    ILDFLNPGYLGARNFFQRRFAVPIEKYGDRSSANALKALVQPFILRRLKS 745
Proma_CCMP1375_SNF2           LMDFLNPKVLGEEDFFNQRYKLPIEHYGDISSLKDLKTQVSPFILRRLKT 802
Proma_MIT\9211_SNF2           LMDFLNPSVLGEKEFFDQRYKLPIERYGDISSLTDLKARVSPFILRRLKS 809
Proma_MIT\9303_SNF2           LMDFLNPRVLGEEDFFRQRYRLPIERYGDMSSLRDLKGRVGPFILRRLKT 842
Proma_MIT9313_SNF2            LMDFLNPRVLGEEDFFRQRYRLPIERYGDMSSLRDLKGRVGPFILRRLKT 842
Syn_sp_CC9311_SNF2            LMDFLNPRVLGEEEFFRHRYRMPIERYGDLSSLRDLKARVGPFILRRLKT 805
Syn_sp_WH\7805_SNF2           LMDFLNPNVLGEEEFFRQRYRMPIERYGDMSSLRDLKSRVGPFILRRLKT 808
Syn_sp_RS9916_SNF2            LMDFLNPRVLGEEDFFRQRYRMPIERYGDMSSLRDLKSRVGPFILRRLKT 803
Syn_sp_CC9605_SNF2            LMDFLNPKVLGEEDFFRQRYRMPIERYGDMSSLRDLKGRVGPFILRRLKT 808
Syn_sp_WH\8102_SNF2           LMDFLSPKVLGEEDFFRQRYRMPIERYGDMASLRDLKARVGPFILRRLKT 806
Syn_sp_CC9902_SNF2            LMDFLNPKVLGEEDFFRQRYRMPIERYGDMSSLRDLKARVGPFILRRLKT 806
Syn_sp_\WH\5701_SNF2          LMDFLNPKVLGEEEFFRQRYRLPIERYGDMASVRDLKARVGPFILRRLKT 781
Myctu_SNF2                    IMDFLNPGLLGSSERFRTRYAIPIERHGHTEPAERLRASTRPYILRRLKT 753
Mycbo_SNF2                    IMDFLNPGLLGSSERFRTRYAIPIERHGHTEPAERLRASTRPYILRRLKT 753
Nocfa_IFM\10152_SNF2          IMDFAVPKLLGTAPTFRARFAVPIERGQDPNALSRLRFLTQPFVLRRVKA 695
Myxxa_DK_SNF2                 ILEFANPGLLGPLETFRRELALPIERHGNQEASARLRRLVSPFVLRRLKS 807
Symth_IAM14863_SNF2           LFQFLNPGLLGSREEFERRYAVPIQRYQDEEAAARLRRQVGPFILRRQKN 737
Metac_C2A_SNF2                IMEFLNPGFLGNQAGFKRNFFIPIQAERDQEAARRLKEITGPFILRRLKT 819
Metma_Go1_SNF2                IMEFLNPGFLGSQAGFKRNFFIPIQAERDQEAARRLKEITGPFILRRLKT 830
Pelph_BU-1_SNF2               LMDFLNPGFLGTQHFFKQNFYTPIQWYGDPEASARLKSLTGPFILRRMKS 748
Archaeon\RC-I_SNF2            IVDFLNPGYLGKAETFRKQFAIPIERYDDAARSEKLKQAIKPLVLRRVKT 779
Nos_sp_PCC7120_SNF2\II        IFNFLNPGYLGKEAQFRKSFEIPIQKDNDKVKSTTLKKLVEPLILRRVKT 796
Bacce_ATCC10987_SNF2          IFDFINHGYLGSLGQFQRRFVSPIEKDRDEGKIQQVQRFISPFLLRRTKK 668
Methu_JF-1_SNF2               IMDFLNPGYLGSQSAFTNRYSRPIEQEKNTELIQELRSLIRPFLLRRMKT 788
                              :.:*     **    *      **:   .      ::    * :*** *
```

FIGURE 8 (continued)

```
Synco_SNF2                  DQTIIQDLPEKQEMTVFCDLSQEQAGLYQQLVEESLQAIADSEG-IQRHG 823
Anava_SNF2                  DRDIIQDLPDKQEMTVFCGLTGEQAALYQKVVETSLAEIESAEG-LQRRG 857
Nostoc_SNF2                 DRDIIQDLPDKQEMTVFCGLTGEQAALYQKAVETSLAEIESAEG-LQRRG 854
Nodsp_SNF2                  DRDIIQDLPEKQEMTVFCGLAAEQAALYQQVVEASLVEIESAEG-LQRRG 874
Lyn_sp_SNF2                 DREIIQDLPEKQENTIFCSLSTEQATLYQKIVDQSLADIDSAAG-IQRRG 838
Crowa_SNF2                  DKTIIQDLPEKQEMTIFCGLSSEQGKLYQQLVDNSLVAIEEKTG-IERKG 834
Synel_PCC6301_SNF2          DRSIIADLPEKQEMTVFCPLVQEQADRYQVLVNEALANIEASEG-IQRRG 803
Synel_PCC7942_SNF2          DRSIIADLPEKQEMTVFCPLVQEQADRYQVLVNEALANIEASEG-IQRRG 803
Theel_BP-1_SNF2             DRSIIQDLPEKQEMLVYCGLTLEQMQLYTAVVEDSLAAIENSQG-IQRRG 789
Glovi_SNF2                  DPQIIQDLPEKQETNVFCPLTPEQAALYERVVNESLAKIEQSTG-IQRRG 794
Proma_CCMP1375_SNF2         DQSIISDLPQKIELNEWVGLSQEQELLYKQTVEKSLDELASLPI-GQRQG 851
Proma_MIT\9211_SNF2         DKSIISDLPSKVELKEWITLSQEQRALYNKTVDNTLQEIARSPI-GQRHA 858
Proma_MIT\9303_SNF2         DKAIISDLPEKVELSEWVGLSKEQAALYRNTVDETLEAIARAPS-GQRHG 891
Proma_MIT9313_SNF2          DKAIISDLPEKVELSEWVGLSKEQAALYRNTVDETLEAIARAPR-GQRHG 891
Syn_sp_CC9311_SNF2          DKAIISDLPEKVELSEWVGLSKEQKSLYAKTVEDTLDAIARAPR-GKRHG 854
Syn_sp_WH\7805_SNF2         DKAIISDLPEKVELSEWVGLSKEQKSLYAKTVENTLDAIARAPR-GKRHG 857
Syn_sp_RS9916_SNF2          DKAIISDLPEKVELSEWVGLSREQKALYAKTVEDTLDAIARAPR-GQRHG 852
Syn_sp_CC9605_SNF2          DKTIISDLPEKVELSEWVGLSKEQKSLYSKTVEDTLDAIARAPR-GQRHG 857
Syn_sp_WH\8102_SNF2         DKTIISDLPEKVELSEWVGLSKEQKSLYSKTVEDTLDAIARAPR-GQRHG 855
Syn_sp_CC9902_SNF2          DKSIISDLPEKVELSEWVGLSKEQKSLYNKTVEDTLDAIATAPR-GQRHG 855
Syn_sp_\WH\5701_SNF2        DRSIISDLPEKVELKEWVGLSPEQVKLYRRTVEDTLDAIARAPV-GQKHG 830
Myctu_SNF2                  DPAIIDDLPEKIEIKQYCQLTTEQASLYQAVVADMMEKIENTEG-IERRG 802
Mycbo_SNF2                  DPAIIDDLPEKIEIKQYCQLTTEQASLYQAVVADMMEKIENTEG-IERRG 802
Nocfa_IFM\10152_SNF2        DPAVIGDLPDKLEMTVRANLTVEQAALYQAVVDDMLVKLRSAKG-MARKG 744
Myxxa_DK_SNF2               DPTIITDLPAKNEMKVVCTLTREQASLYKAVVDEELRRIEEADG-MERRG 856
Symth_IAM14863_SNF2         DPAIAPDLPDKLENTELVTLSVEQAALYEAIVQETLERAAQADG-IQRQA 786
Metac_C2A_SNF2              DTSIISDLPEKMEMKTYCTLTKEQASLYAAVLEDIEETMEEAEEGIQRKG 869
Metma_Go1_SNF2              DTSIISDLPEKMEMKTYCTLTKEQASLYAAVLEDIREAIEGAEEGIQRKG 880
Pelph_BU-1_SNF2             DKSIISDLPDKIEMKEYCSLTKEQASLYKAVVDELQEKIESAEG-IDRRG 797
Archaeon\RC-I_SNF2          DPAIIKDLPDKIEIKEPCNLTKEQATLYEAIVENMLKSIDKATA-MQRRG 828
Nos_sp_PCC7120_SNF2\II      DQSIIKDLPDKVEQKLYTNLTKEQASLYEVVVRDVEEKLQEAEG-IQRKG 845
Bacce_ATCC10987_SNF2        DQTVALNLPDKQEQKAYCPLTGEQASLYEQLVQDTLQNVEGLSG-IERRG 717
Methu_JF-1_SNF2             DKHVIDDLPEKMENRVYCTLTPEQATLYQAVVLDMAKNLDKVEG-IARKG 837
                            *  :  :** * *      *  **   *   :              ::.
```

FIGURE 8 (continued)

```
                                                                                
Synco_SNF2                  LVLTLLTKLKQVCNHPDLL----------LKKPAITHGH--QSGKLIRL 860
Anava_SNF2                  MILALLIKLKQICNHPAQY----------LKTNTLEQY---SSGKLQRL 893
Nostoc_SNF2                 MILALLIKLKQICNHPAQY----------LKINTLEQH---SSGKLQRL 890
Nodsp_SNF2                  MILALLVKLKQICNHPAQY----------LKAATLQEH---SSAKLQRL 910
Lyn_sp_SNF2                 MILALLVKLKQVCNHPILLNGKATKTGKKKVETQGLSLQ---SSGKLQRF 885
Crowa_SNF2                  LILSLLLKLKQICNHPAHF----------LKQKSLKTAE--QSGKLLRL 871
Synel_PCC6301_SNF2          QILALLTRLKQLCNHPSLL----------LEKPKLDPNFGDRSAKLQRL 842
Synel_PCC7942_SNF2          QILALLTRLKQLCNHPSLL----------LEKPKLDPNFGDRSAKLQRL 842
Theel_BP-1_SNF2             NILATLTKLKQICNHPAQY----------LKQEDYAP---DRSGKLQRL 825
Glovi_SNF2                  TVLATLVKLKQICNHPSHY----------LGDDGPLAN---RSGKLSRL 830
Proma_CCMP1375_SNF2         KTLGLLTRLKQICNHPAIA----------LKETQVEKNFLLRSSKLQRL 890
Proma_MIT\9211_SNF2         KTLGLLTRLKQICNHPALA----------LKEKNISDDFGIRSTKLQRL 897
Proma_MIT\9303_SNF2         KVLGLLTRLKQICNHPALA----------LKEKTVAKGFMDRSAKLLRL 930
Proma_MIT9313_SNF2          KVLGLLTRLKQICNHPALA----------LKEQTVAKGFMDRSAKLLRL 930
Syn_sp_CC9311_SNF2          QVLGLLTKLKQICNHPALA----------LKEQGASEDFLKRSVKLQRL 893
Syn_sp_WH\7805_SNF2         QVLGLLTRLKQICNHPALA----------LKEEVAGDDFLQRSVKLQRL 896
Syn_sp_RS9916_SNF2          QVLGLLTKLKQICNHPALA----------LKEEAAGDEFLQRSMKLQRL 891
Syn_sp_CC9605_SNF2          QVLALLTRLKQICNHPALA----------LSEGAVDDGFLGRSAKLQRL 896
Syn_sp_WH\8102_SNF2         QVLGLLTRLKQICNHPALA----------LSENAVDDGFLGRSAKLQRL 894
Syn_sp_CC9902_SNF2          QVLALLTRLKQICNHPALA----------QREGAVDSEFLGRSAKLMRL 894
Syn_sp_\WH\5701_SNF2        QVLGLLTKLKQVCNHPALM----------LKEGEVGAGFSARSAKLQRL 869
Myctu_SNF2                  NVLAAMAKLKQVCNHPAQL----------LHDRSPVGRR----SGKVIRL 838
Mycbo_SNF2                  NVLAAMAKLKQVCNHPAQL----------LHDRSPVGRR----SGKVIRL 838
Nocfa_IFM\10152_SNF2        AVLGALTRLKQVCNHPAHF----------LGDGSPVLHRGRHRSGKLALV 784
Myxxa_DK_SNF2               RVLALLLYTKQIANHPAQY----------LGESGPLPGR----SGKLARV 892
Symth_IAM14863_SNF2         AVLAGLTRLKQVCNHPAAA----------TGD-GPLVGR----SGKIDRL 821
Metac_C2A_SNF2              IILSALTRLKQVCNHPAQFLK----------DNSAVPG----RSGKLARL 905
Metma_Go1_SNF2              IILSALSRLKQVCNHPAQFLK----------DNSTIPG----RSGKLARL 916
Pelph_BU-1_SNF2             LVLALLVKLKQVCNHPAHLLG----------DNSAIAH----RSGKIKRL 833
Archaeon\RC-I_SNF2          IVLASLMKLKQVCDHPSLYIK----------TGAVTDDKTLIRSGKLKRL 868
Nos_sp_PCC7120_SNF2\II      LILSTLMKLKQICNHPRQFLQ----------DNSEFLPE---RSHKLSRL 882
Bacce_ATCC10987_SNF2        FILLMLNKLKQICNHPALYL------------KETEPKDIIERSMKTSTL 755
Methu_JF-1_SNF2             AILAAITRLKQICNHPGRVG------------RDKTIK--AERSGKVSRL 873
                              *  :   **:.:**                           * *   .
```

FIGURE 8(continued)

```
Synco_SNF2                  AEMLEEIISEG--------DRVLIFTQFASWGHLLKPYLEKYFN---QEV 899
Anava_SNF2                  EEMLEEVLAESNTYGVAGAGRALIFTQFAEWGKLLKPHLEKQLG---REV 940
Nostoc_SNF2                 EEMLEEVLAESNTYGVAGAGRALIFTQFAEWGKLLKPHLEKQLG---REI 937
Nodsp_SNF2                  DEMLTVALEEG--------DRALIFTQFAEWGKLLKAHLQQTLG---KEI 949
Lyn_sp_SNF2                 KEMLEELLSEG--------DRAIVFTQFAEWGKVLQPYLEQQLN---REV 924
Crowa_SNF2                  EEMLEELIEEG--------DHALIFTQFSEWGKLLQPYLQKKFQ---QDV 910
Synel_PCC6301_SNF2          LEMLAELTDAG--------DRALVFTQFAGWGSLLQQFLQEQLG---REV 881
Synel_PCC7942_SNF2          LEMLAELTDAG--------DRALVFTQFAGWGSLLQQFLQEQLG---REV 881
Theel_BP-1_SNF2             IEMLQALQEVG--------DRALVFTQFAEFGTHLKTYLEKALQ---QEV 864
Glovi_SNF2                  GEMLEEVLADE--------ERALIFTQFAEWGHLLQAHLSRQLG---SEV 869
Proma_CCMP1375_SNF2         EEILQEVKESH--------DRALLFTQFAEWGHLLQAYLQTKWE---SEV 929
Proma_MIT\9211_SNF2         EELLDVIFATE--------DRALLFTQFAEWGHLLQAYLEKKWG---HSI 936
Proma_MIT\9303_SNF2         EEILEEVIEAG--------DRALLFTQFAEWGHLLKAYLQQRWR---FEV 969
Proma_MIT9313_SNF2          EEILEEVIEAG--------DRALLFTQFAEWGHLLKAYLQQRWR---FEV 969
Syn_sp_CC9311_SNF2          EEILDEVVEAG--------DRALLFTQFAEWGKLLQDYLQRRWR---SEV 932
Syn_sp_WH\7805_SNF2         EEILEEVIAAG--------DRALLFTQFAEWGHLLQGYLQRRWR---SEV 935
Syn_sp_RS9916_SNF2          EEILEEVIDAG--------DRALLFTQFAEWGHLLQGYLQRRWR---SEV 930
Syn_sp_CC9605_SNF2          EEILDEVIEAG--------DRALLFTQFAEWGHLLRAWMQQRWK---SEV 935
Syn_sp_WH\8102_SNF2         EEILDEVIEAG--------DRALLFTQFAEWGHLLQSWMQQRWK---ADV 933
Syn_sp_CC9902_SNF2          EEILEEVIEAG--------DRALLFTQFAEWGHLLQAWMQQRWK---SEV 933
Syn_sp_\WH\5701_SNF2        EEIVEEVIAAG--------DRALLFTQFAEWGHLLQTHLQQRFH---QEV 908
Myctu_SNF2                  EEILEEILAEG--------DRVLCFTQFTEFAELLVPHLAARFGRAARDI 880
Mycbo_SNF2                  EEILEEILAEG--------DRVLCFTQFTEFAELLVPHLAARFGRAARDI 880
Nocfa_IFM\10152_SNF2        EDVLDTVVADG--------EKALLFTQFREFGDLLAPYLSERFG---API 823
Myxxa_DK_SNF2               VEMLEESLAAG--------DKALVFTQFREMGDKLVAHLSEYLG---HEV 931
Symth_IAM14863_SNF2         VQLLQEVLAAG--------EQALLFTQFARFGGRLQAYLAETLG---CEV 860
Metac_C2A_SNF2              TEMLDVILENG--------EKALVFTQFAEMGKMLKEHLQASFG---CEV 944
Metma_Go1_SNF2              TEMLDVVLENG--------EKALVFTQFAEMGKMVKEHLQASFG---CEV 955
Pelph_BU-1_SNF2             TELLGDIREAG--------EKTLLFTQFTMMGTMLQHYLQELYG---EEV 872
Archaeon\RC-I_SNF2          TELLEEALAEG--------DSVLIFTQFVEMGEMLKAYLQSTFD---EEA 907
Nos_sp_PCC7120_SNF2\II      VEMVDEAISEG--------ESLLIFSQFTEVCEQIEKYLKHNLH---CNT 921
Bacce_ATCC10987_SNF2        MELIENIKDQN--------ESCLIFTQYIGMGNMLKDVLEEHFG---QRV 794
Methu_JF-1_SNF2             LEMIEEITSEG--------DSALIFSQYATFAEELAGMIEKQGD---TPV 912
                             :::                : *:*:      :   :
                                                Motif IV
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FIGURE 8 (continued)

```
Synco_SNF2                    LYLHGGTPAEQRQALVERFQ-QDPNSPYLFILSLKAGGTGLNLTRANHVF 948
Anava_SNF2                    FFLYGSTSKKQREEMIDRFQ-HDPQGPPIMILSLKAGGVGLNLTRANHVF 989
Nostoc_SNF2                   FFLYGGTSKKQREEMIDRFQ-HDPQGPPIMILSLKAGGVGLNLTRANHVF 986
Nodsp_SNF2                    FFLYGGSSKKQREEMIDRFQ-HDPQGPPIMILSLKAGGVGLNLTRANHVF 998
Lyn_sp_SNF2                   LFLYGATRKNKREEMIDRFQ-QDPQGPPIFILSLKAGGVGLNLTRANHVF 973
Crowa_SNF2                    LFLYGATRRVQRQEMIDRFQ-QDPNGPRIFILSLKAGGTGLNLTRANHVF 959
Synel_PCC6301_SNF2            LFLSGSTKKGDRQQMVDRFQ-NDPQAPAIFILSLKAGGVGLNLTKANHVF 930
Synel_PCC7942_SNF2            LFLSGSTKKGDRQQMVDRFQ-NDPQAPAIFILSLKAGGVGLNLTKANHVF 930
Theel_BP-1_SNF2               FFLSGRTPKAQRELMVERFQ-HDPEAPRVFILSLKAGGVGLNLTRANHVF 913
Glovi_SNF2                    FFLYGGTSKNQREAMIERFQ-SDPQGPRIFILSLKAGGVGLNLTRANHVF 918
Proma_CCMP1375_SNF2           PFLHGGTPKGKRQEMIDRFQ-DDPRGPNIFLLSLKAGGVGLNLTRANHVF 978
Proma_MIT\9211_SNF2           LFLHGGTRKIDRQSMVDQFQ-EDPRGPKLFLLSLKAGGIGLNLTRANHVL 985
Proma_MIT\9303_SNF2           PFLHGSTSKTERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 1018
Proma_MIT9313_SNF2            PFLHGSTSKTERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 1018
Syn_sp_CC9311_SNF2            PFLSGSTSKSERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 981
Syn_sp_WH\7805_SNF2           PFLSGSTSKGERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 984
Syn_sp_RS9916_SNF2            PFLNGSTSKSERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 979
Syn_sp_CC9605_SNF2            PFLHGGTRKNERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 984
Syn_sp_WH\8102_SNF2           PFLHGGTRKNERQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 982
Syn_sp_CC9902_SNF2            PFLHGGTRKSDRQAMVDRFQ-EDPRGPQLFLLSLKAGGVGLNLTRASHVF 982
Syn_sp_\WH\5701_SNF2          PFLYGSTSKGERQAMVDRFQ-DDPRGPQLFLLSLKAGGVGLNLTRASHVF 957
Myctu_SNF2                    AYLHGGTPRKRRDEMVARFQ-SGDGPP-IFLLSLKAGGTGLNLTAANHVV 928
Mycbo_SNF2                    AYLHGGTPRKRRDEMVARFQ-SGDGPP-IFLLSLKAGGTGLNLTAANHVV 928
Nocfa_IFM\10152_SNF2          PFLHGGVTKKNRDTMVERFQ-SGDGPP-VMLLSLKAGGTGLTLTAANHVV 871
Myxxa_DK_SNF2                 LFLHGGTPRKARDEMVRRFQ-EDVHGPRVFVLSVKAGGTGLNLTAASHVF 980
Symth_IAM14863_SNF2           LFLHGGTPQPERDRLVARFQ-AGEAP--LFILSLKAGGLGLNLTAATHVF 907
Metac_C2A_SNF2                LFLHGGVPRKQRDRMLERFQEGKEYLP-IFVLSLKAGGTGLNLTGANHVF 993
Metma_Go1_SNF2                LFLHGGVPRKQRDRMLERFQEGKEYLP-IFVLSLKAGGTGLNLTGANHVF 1004
Pelph_BU-1_SNF2               LFLHGGVTKKRRDEMVESFQKEEGSSPSIFILSLKAGGTGLNLTTANHVV 922
Archaeon\RC-I_SNF2            LFLHGGVPQKARDKMVLRFGEKD--GPRIFIVSLKAGGVGLNLTKASHVF 955
Nos_sp_PCC7120_SNF2\II        YYLHGGTSRQRREQMISDFQ-NPDTEASVFVLSLKAGGVGITLTKANHVF 970
Bacce_ATCC10987_SNF2          LFLNGSVPKKERDKMIEQFQ--NG-TYDIFILSLKAGGTGLNLTAANHVI 841
Methu_JF-1_SNF2               LLLTGSTPRKKREQMIEEFQ--ASTTPIIFVISLKAGGTGLNLTKATHVF 960
                                * *      *: ::  *         ::::*:**** *:.** *.**.
                                                          MOTIF V
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Synco_SNF2                HVDRWWNPAVENQATDRAFRIGQTRNVQVHKFVCTGTLEEKINAMMADKQ 998
Anava_SNF2                HFDRWWNPAVENQATDRVFRIGQTRNVQVHKFVCNGTLEEKIHDMIESKK 1039
Nostoc_SNF2               HFDRWWNPAVENQATDRVFRIGQTRNVQVHKFVCNGTLEEKIHDMIESKK 1036
Nodsp_SNF2                HFDRWWNPAVENQATDRVFRIGQTRNVQVHKFVCTGTLEEKIHDMIESKK 1048
Lyn_sp_SNF2               HFDRWWNPAVENQATDRVFRIGQTRNVQVHKFVCTGTLEEKIHDLIESKK 1023
Crowa_SNF2                HIDRWWNPAVENQATDRAFRLGQKRNVQVHKFVCTGTLEEKINEMLESKQ 1009
Synel_PCC6301_SNF2        HYDRWWNPAVENQATDRAFRIGQRRNVQVHKFVCAGTLEEKIDQMIASKQ 980
Synel_PCC7942_SNF2        HYDRWWNPAVENQATDRAFRIGQRRNVQVHKFVCAGTLEEKIDQMIASKQ 980
Theel_BP-1_SNF2           HYDRWWNPAVENQASDRVFRIGQARNVQIHKFICTGTLEEKIHEQIEQKK 963
Glovi_SNF2                HFDRWWNPAVENQATDRVFRIGQTKNVQVYKYVCTGTLEERINALIESKK 968
Proma_CCMP1375_SNF2       HIDRWWNPAVENQATDRAYRIGQKKSVIVHKFITTGTIEEKINQMILEKT 1028
Proma_MIT\9211_SNF2       HIDRWWNPAVENQATDRAYRIGQKNSVMVHKFIATGSVEEKIDQMITEKS 1035
Proma_MIT\9303_SNF2       HVDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKS 1068
Proma_MIT9313_SNF2        HVDRWWNPAVENQATDRAYRIGQTSRVMVHKFITSGSVEEKIDRMIREKS 1068
Syn_sp_CC9311_SNF2        HIDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKS 1031
Syn_sp_WH\7805_SNF2       HIDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKS 1034
Syn_sp_RS9916_SNF2        HIDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKS 1029
Syn_sp_CC9605_SNF2        HIDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKS 1034
Syn_sp_WH\8102_SNF2       HIDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKS 1032
Syn_sp_CC9902_SNF2        HVDRWWNPAVENQATDRAYRIGQTNRVMVHKFVTRGSVEEKIDQMIREKA 1032
Syn_sp_\WH\5701_SNF2      HIDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKA 1007
Myctu_SNF2                HLDRWWNPAVENQATDRAFRIGQRRTVQVRKFICTGTLEEKIDEMIEEKK 978
Mycbo_SNF2                HLDRWWNPAVENQATDRAFRIGQRRTVQVRKFICTGTLEEKIDEMIEEKK 978
Nocfa_IFM\10152_SNF2      HLDRWWNPAVENQATDRAFRIGQRRDVQVRKLVCVDTIEERIDEMITGKS 921
Myxxa_DK_SNF2             HYDRWWNPAVEDQATDRAYRIGQTRAVQVHKLVCAGTVEEKVDRLLEQKR 1030
Symth_IAM14863_SNF2       HVDRWWNPAVEDQATDRAYRIGQTRRVLVHRLITAGTLEERIDRLLAEKR 957
Metac_C2A_SNF2            HFDRWWNPAVENQATDRAFRIGQTKNVEVHKFICAGTLEEKIDEIIERKV 1043
Metma_Go1_SNF2            HFDRWWNPAVENQATDRAFRIGQKKNVEVHKFICAGTLEEKIDEIIERKV 1054
Pelph_BU-1_SNF2           HFDRWWNPAVENQATDRAFRIGQHKNVEVHKFITTGTLEERIDEMIEKKT 972
Archaeon\RC-I_SNF2        HFDRWWNPAVENQATDRAYRIGQSKNVLVHKFVCAGTLEEKIDELIESKK 1005
Nos_sp_PCC7120_SNF2\II    HFDRWWNPAVEDQATDRAFRIGQKKNVFVHKFVALGTLEERIDQMIEDKK 1020
Bacce_ATCC10987_SNF2      HYDRWWNPAVENQATDRAYRIGQKRFVHVHKLITTGTLEEKIDEMLERKQ 891
Methu_JF-1_SNF2           HVDRWWNPAVEDQATDRTYRIGQKRNVQVHLMITAGTLEERIDLINQEKR 1010
                          * *********:**:**.:*:**   * :   :  .::**::.     *
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Motif Va Motif VI

FIGURE 8 (continued)

FIGURE 8 (continued)

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Synco_SNF2                      QLAEQTVDAGENWLTRLDTDKLRQLLTLSATPVDYQAEASD--------- 1039
Anava_SNF2                      QLAEQVVGAGEEWLTELDTDQLRNLLILDRSAVIDEEAE----------- 1078
Nostoc_SNF2                     QLAEQVVGAGEEWLTELDTDQLRNLLILDRSTVIDEEAD----------- 1075
Nodsp_SNF2                      QLAEQVVGAGEEWLTEMNTDQLRDLLILDRSAIIDEDEV----------- 1087
Lyn_sp_SNF2                     VLAEQVVGSGENWLTELDTDQLRNLLIIDRNAVIDEEE------------ 1061
Crowa_SNF2                      KLAEQTVDAGEQWLTELDTDQLRNLLLLDRDTIIDEQ------------- 1046
Synel_PCC6301_SNF2              ALAQQIVGSGEDWLTELDTNQLRQLLILDRSAWVEEEEP----------- 1019
Synel_PCC7942_SNF2              ALAQQIVGSGEDWLTELDTNQLRQLLILDRSAWVEEEEP----------- 1019
Theel_BP-1_SNF2                 ALAEMIVGSGEHWLTELNLDQLRQLLTLDKERLITL-------------- 999
Glovi_SNF2                      ALAEQVVSAGENWLSDLNTDQLRQLLVLDRSEIIDTEDTA---------- 1008
Proma_CCMP1375_SNF2             ELAENIVGSGESWLGQLSLEKLSELVALDSNPEF---------------- 1062
Proma_MIT\9211_SNF2             KLAENIIGAGEDWLGKLGINELRELVSLEKES------------------ 1067
Proma_MIT\9303_SNF2             RLAEDIIGSGEDWLGGLGVSQLRELVALEDS------------------- 1099
Proma_MIT9313_SNF2              RLAEDIIGSGEDWLGGLGVSQLRELVALEDS------------------- 1099
Syn_sp_CC9311_SNF2              RLAEDIIGSGEDWLGGLEMGQLKELVSLEDNQA----------------- 1064
Syn_sp_WH\7805_SNF2             RLAEDIVGSGEEWLGGFDMGQLKELVSLEDNETRNP-------------- 1070
Syn_sp_RS9916_SNF2              RLAEDIIGSGEDWLGGLDMGQLKELVSLDDNGSLSA-------------- 1065
Syn_sp_CC9605_SNF2              RLAEDVIGSGEDWLGSLGGDQLRDLVSLEDT------------------- 1065
Syn_sp_WH\8102_SNF2             RLAEDVIGSGEDWLGCLAGDQLRNLVALEDT------------------- 1063
Syn_sp_CC9902_SNF2              RMAEDVIGSGEDWLGSLGGDQLRNLVALEDT------------------- 1063
Syn_sp_\WH\5701_SNF2            RLAEDIVGSGEEWLGGLDPGQLRDLVALEE-------------------- 1037
Myctu_SNF2                      ALADLVVTDGEGWLTELSTRDLREVFALSEGAVGE--------------- 1013
Mycbo_SNF2                      ALADLVVTDGEGWLTELSTRDLREVFALSEGAVGE--------------- 1013
Nocfa_IFM\10152_SNF2            RLADLAVDAGENWITELGTEELRELFTLGAEAVGE--------------- 956
Myxxa_DK_SNF2                   QLAEKVVGAGEHWVTELDTTALRELFSLSEGAVADDGDAEGEDDARVRAP 1080
Symth_IAM14863_SNF2             ALAGQVIISGESWLGQLSTEELRALIALDREV------------------ 989
Metac_C2A_SNF2                  QVAENVVGTGEGWLTELSNEELKDILALREEAVGE--------------- 1078
Metma_Go1_SNF2                  QVAENVVGTGEDWLTELSNDELKDILALREEAVGE--------------- 1089
Pelph_BU-1_SNF2                 TVAGQVLGTGEQWLTELSNNDLRKLIMLGQEAMGE--------------- 1007
Archaeon\RC-I_SNF2              ALSANILGTGEDWITELSTEQLRDMVMLRWDEVADDG------------- 1042
Nos_sp_PCC7120_SNF2\II          KLSSAVVGSDESWLTELDNEAFKKLIALNKSTIME--------------- 1055
Bacce_ATCC10987_SNF2            SLNNAVIT-SDSWMTELSTDELKELLGV---------------------- 918
Methu_JF-1_SNF2                 TLAKEVLAQSDEYLTNLSTKELLEIVSLRDSLFRGEDA------------ 1048
                                 :    :  .: ::  :    :  :. :
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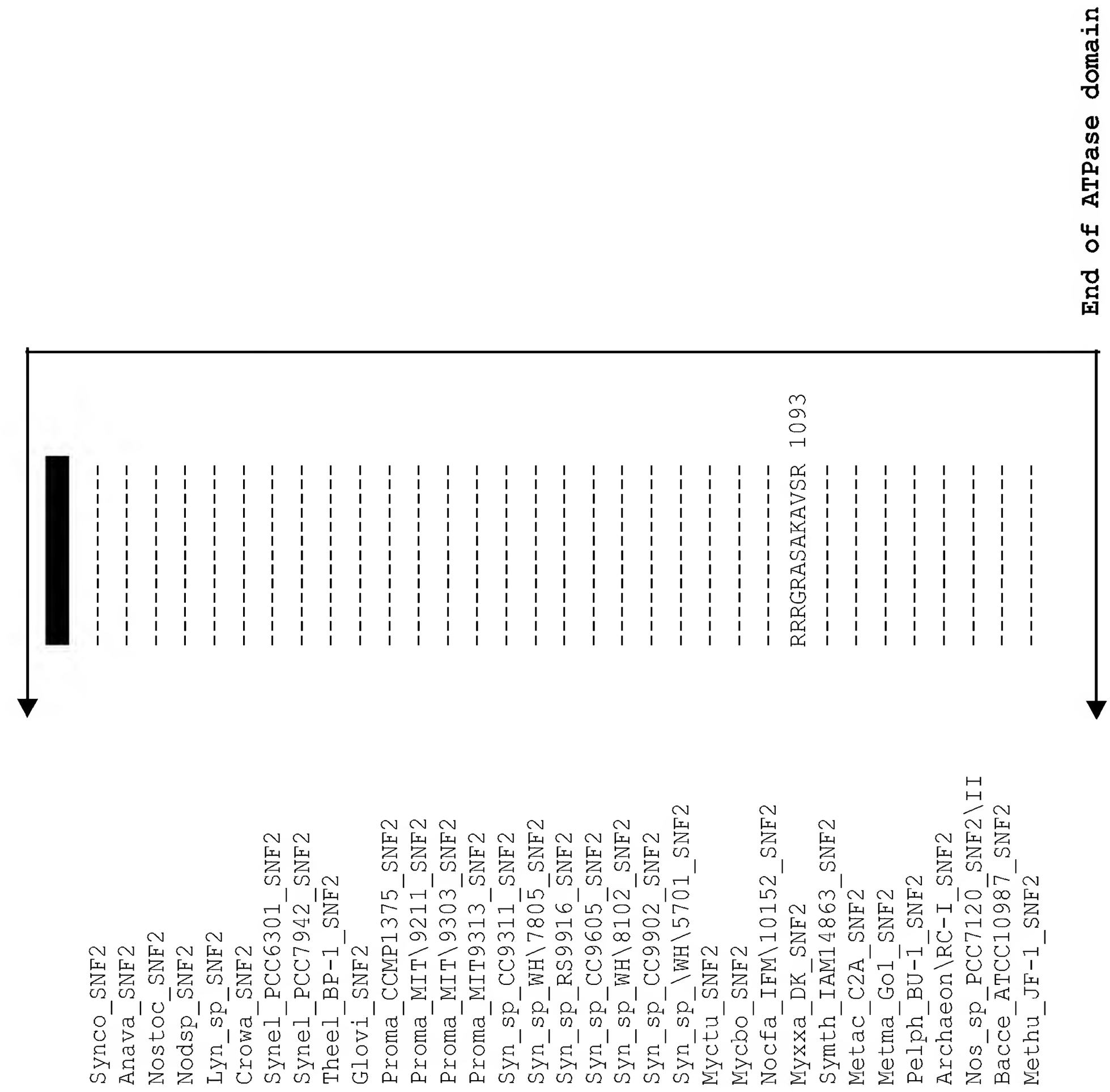

FIGURE 8 (continued)

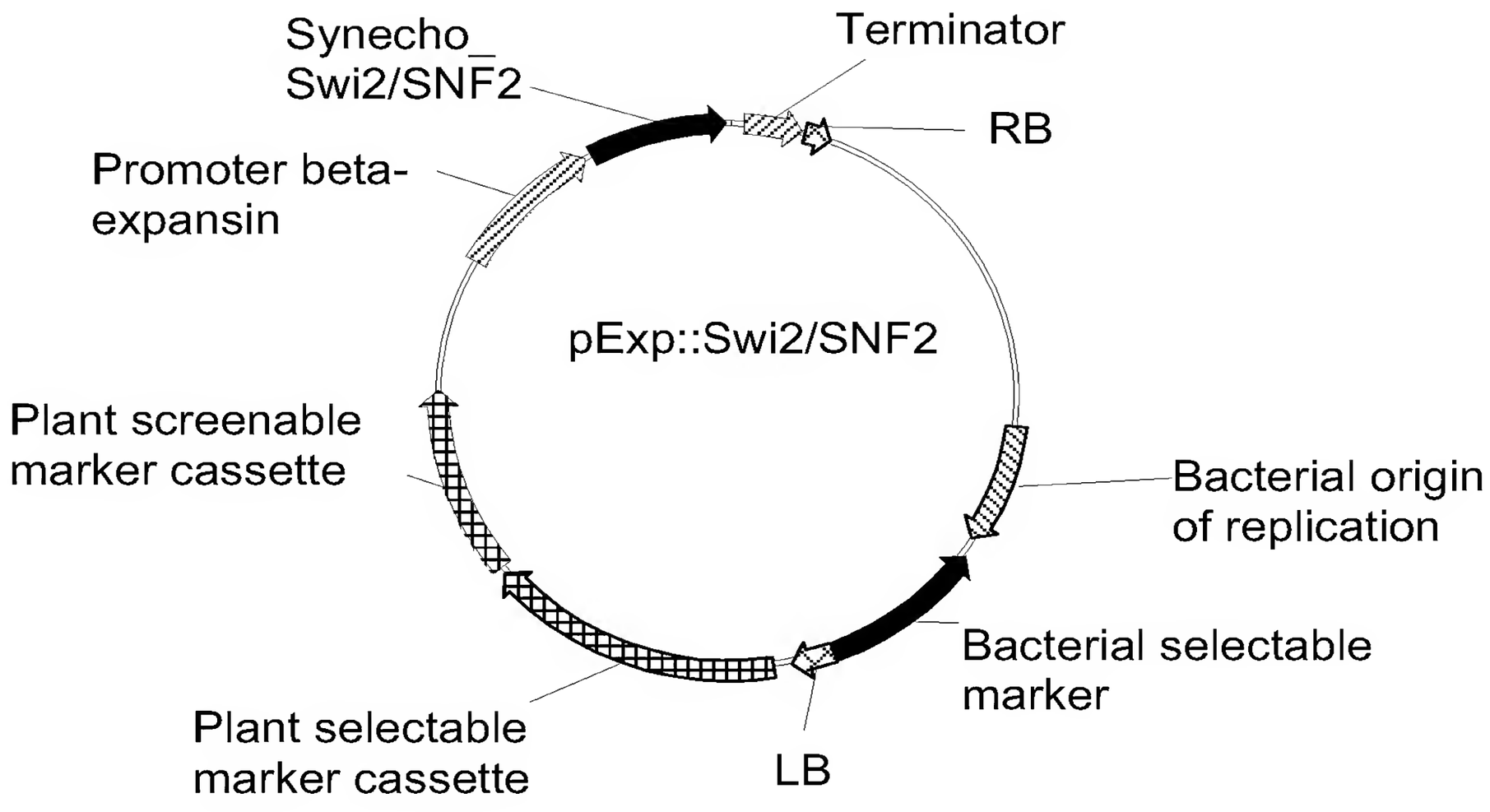
Synecho_
Swi2/SNF2
Terminator
RB
Promoter beta-
expansin
pExp::Swi2/SNF2
Plant screenable
marker cassette
Bacterial origin
of replication
Bacterial selectable
marker
Plant selectable
marker cassette
LB

FIGURE 9

SEQ ID NO: 29, Synechocystis sp. PCC 6803 BA000022 Synecho_PCC6803_SNF2 nucleic acid sequence

TGTTCGTTGCACAAATTGATGAGCAATGCTTTTTTATAATGCCAACTTTGTACAAAAAAGCAGGCT
TAAACAATGGCGACTATCCACGGTAATTGGCAACCCTCCCACGGGGAAAACGGCGGCAAACTGTTT
CTTTGGGCGGATACCTGGGGTCATCCTTTGCCAGAAACCATTGGCGATCGCCATCCCTTTGCGTTG
GATCTGCCGGATTTGCTACAGGCCTGGTCGAATTTGCCCCTGGCCTTCCCCAAGGCGGATGGGGTG
ACAGAGGCAGCCCTTACTCTGCATTTACCCAGCCATCGCCAGCAAAAAATTCCCCTACCCTTTGTC
ACAGGGCAAGATCCGGTGGCCATGGATGCGAAATATCTCCACTGGCGATCGTGGCAGGTAACCGGG
GTAAATCTGACCCCAAGCCAAACGTTAACGTTGCTCCAATCTATTCCCCTGGGGGGCCAAGCCTTA
GCTAACTTAGGATCAGAGTTTTACTTTTACGGTCAACTGCACCGCTGGTGTTTAGATTTGGTGCTA
CGGGGTAAATTTGTGCCGGGACTGGAGCAAAGGGGGGAAGACGGTAATTACTATGCCCAATGGATT
CCTATCCTCGATAGCATCCAAGACCAAACCCATTTAGCCCAATTTAGCCAGAGAGTACCTGCCTGC
GCCCTGGCCAACCTGACTGACTCCCAGGAGCCCCAAATGTTGGTGGTGGATTTACTACAAAAATTA
TTGCAAGCCCAAATTGGTGCCGTCAGTCCCAGCCTAGCCAACGTTAAAGAAGTCTGGTTGAATGAT
TGGCTCCGGGGATTAACCCATGGGGGGCAAACCTCCCTCGGCACAAGCAAAGCTCTACAACGATTA
GCCACATCCTTAGACCATTGGTATTTACCAGTCCAGAATTATTTGGGCCAAAAAAATAACCAAGCT
TTAGCCCAACGGCAATGGCGGGGGGCTCTGCGGTTACAACCTCCAGCGGACGATGGGGGGGGAACC
TGGCAACTGGATTATGGTTTACAAGCCCTGGATGACGGGGAATTTTGGCTCCCGGCGGCTTCCCTC
TGGGCCATGGCCGGCGATCGCCTGGTGTGGCAGGGAAGGAGGGTTGACCAGGGGGCGGAAAGTTTA
CTGCGGGGCTTAGGGGTAGCTGCCCAAATTTACGAACCCATTGCTGCAAGTTTGACGGAAAGGTGT
CCCACGGGCTGTGGGCTAGATGCCATCCAAGCCTACGAATTTATCCTGGCAATCGCCCATCAATTG
CGGGATCGGGGGGTTAGGGGTAATCCTCCCGCCGGGGTTAGAACGGGGCGGCACCGCCAAACGGTTA
GGGGTAAAAGTGGTGGGGGAAGTGCAACGGCAAAGGGGCCAGCGGCTAACTCTGCAAAGTTTAATT
AATTACGACTTGCAACTAATGATGGGGAGCGGGGACAATGCCCGGTTATTGACGGCCAAGGACTTT
GAAGCGTTACTAGCCCAAAAATCTCCCCTGGTGGTGCTGGACGGAGAATGGATTACCCTGCAACCG
GCGGACGTGCGGGCGGCCAAGGTCATTTTACAGCAGCAACAATCTGCCCCGCCCCTCACAGTGGAG
GATGCTCTGCGCCTCAGCATTGGTGATTTACAAACCGTCTCTAAACTGCCGGTGACCCAGTTTGCT
GCTCGGGGCATATTACAGGAATTGATCGACACCCTCCGTAACCCGGAAGGAGTGAAAGCCATTGCT
GACCCACCGGGCTTTCAGGGTACTTTACGGCCCTACCAAGCTCGGGGAGTGGGCTGGTTAGCTTTT
CTGGAACGGTGGGGGCTGGGGGCCTGTTTGGCAGACGATATGGGTTTGGGAAAAACACCCCAGTTG
CTGGCTTTTCTGCTCCATTTAGCCGCGGAGGATATGTTAGTTAAGCCGGTGTTGATTGTTTGTCCT
ACGTCGGTGCTGAGCAATTGGGGTCATGAAATTAATAAGTTTGCGCCCCAACTTAAAACCCTATTG
CACCATGGCGATCGCCGGAAAAAAGGGCAACCGTTGGTTAAACAGGTCAAAGACCAGCAAATTGTC
CTCACCAGTTACGCTTTACTGCAACGGGATTTTAGTAGTTTGAAATTGGTGGACTGGCAGGGGATC
GTGCTGGACGAAGCCCAAAATATCAAAAATCCCCAAGCTAAACAGTCCCAGGCGGCCCGGCAATTG
CCAGCGGGTTTTCGCATTGCCCTCACGGGGACTCCGGTGGAAAATCGCCTGACGGAATTGTGGTCA
ATTTTAGAATTTTTAAATCCCGGTTTCCTGGGTAATCAGAGCTTTTTCCAACGGCGCTTTGCCAAT
CCCATCGAAAAATTTGGCGATCGCCAGTCGTTGTTAATTTTGCGGAATTTAGTGCGGCCGTTTATT
TTGCGGCGGTTAAAAACCGACCAAACCATTATTCAAGATTTACCAGAAAAACAAGAAATGACCGTC
TTCTGTGACCTTTCCCAAGAGCAAGCTGGTTTATATCAACAATTGGTGGAGGAATCCCTCCAGGCG
ATCGCCGACAGCGAAGGCATTCAAAGGCACGGTTTAGTTTTAACCCTATTAACCAAACTCAAACAG
GTTTGTAACCATCCCGATCTATTGCTGAAAAAGCCCGCCATCACCCACGGGCACCAGTCCGGCAAG
CTAATTCGTCTGGCGGAAATGCTGGAAGAAATCATCAGCGAAGGCGATCGGGTGTTAATTTTCACC
CAATTTGCCAGTTGGGGTCATTTACTCAAACCCTATCTGGAAAAATACTTTAACCAAGAGGTGCTC
TATCTCCACGGGGGCACTCCAGCAGAGCAACGGCAAGCTCTGGTGGAACGATTCCAACAGGACCCC
AACAGTCCCTATTTATTTATCCTTTCTCTCAAGGCTGGCGGCACAGGGTTGAACCTCACGAGGGCT
AACCATGTGTTCCATGTGGACCGGTGGTGGAATCCGGCGGTGGAAAATCAGGCTACCGATCGTGCT
TTTCGCATTGGCCAAACTCGCAACGTCCAGGTGCACAAATTTGTCTGTACAGGCACCTTGGAAGAA

FIGURE 10

AAAATTAACGCCATGATGGCGGATAAACAACAATTGGCAGAACAAACCGTGGATGCCGGGGAAAAT
TGGCTCACCCGCCTAGACACCGATAAACTCCGTCAGTTGCTTACCCTCTCCGCCACCCCGGTGGAT
TACCAAGCCGAAGCGTCCGATTGAACCCAGCTTTCTTGTACAAAGTTGGCATGATAAGAAAGCATT
GCTTATCAATTTGTTGCAACGAACAGGTCACTATCAGTCAAAATAAAT

SEQ ID NO: 30, Synechocystis sp. PCC 6803 BA000022 Synecho_PCC6803_SNF2 translated polypeptide

MATIHGNWQPSHGENGGKLFLWADTWGHPLPETIGDRHPFALDLPDLLQAWSNLPLAFPKADGVTE
AALTLHLPSHRQQKIPLPFVTGQDPVAMDAKYLHWRSWQVTGVNLTPSQTLTLLQSIPLGGQALAN
LGSEFYFYGQLHRWCLDLVLRGKFVPGLEQRGEDGNYYAQWIPILDSIQDQTHLAQFSQRVPACAL
ANLTDSQEPQMLVVDLLQKLLQAQIGAVSPSLANVKEVWLNDWLRGLTHGGQTSLGTSKALQRLAT
SLDHWYLPVQNYLGQKNNQALAQRQWRGALRLQPPADDGGGTWQLDYGLQALDDGEFWLPAASLWA
MAGDRLVWQGRRVDQGAESLLRGLGVAAQIYEPIAASLTERCPTGCGLDAIQAYEFILAIAHQLRD
RGLGVILPPGLERGGTAKRLGVKVVGEVQRQRGQRLTLQSLINYDLQLMMGSGDNARLLTAKDFEA
LLAQKSPLVVLDGEWITLQPADVRAAKVILQQQQSAPPLTVEDALRLSIGDLQTVSKLPVTQFAAR
GILQELIDTLRNPEGVKAIADPPGFQGTLRPYQARGVGWLAFLERWGLGACLADDMGLGKTPQLLA
FLLHLAAEDMLVKPVLIVCPTSVLSNWGHEINKFAPQLKTLLHHGDRRKKGQPLVKQVKDQQIVLT
SYALLQRDFSSLKLVDWQGIVLDEAQNIKNPQAKQSQAARQLPAGFRIALTGTPVENRLTELWSIL
EFLNPGFLGNQSFFQRRFANPIEKFGDRQSLLILRNLVRPFILRRLKTDQTIIQDLPEKQEMTVFC
DLSQEQAGLYQQLVEESLQAIADSEGIQRHGLVLTLLTKLKQVCNHPDLLLKKPAITHGHQSGKLI
RLAEMLEEIISEGDRVLIFTQFASWGHLLKPYLEKYFNQEVLYLHGGTPAEQRQALVERFQQDPNS
PYLFILSLKAGGTGLNLTRANHVFHVDRWWNPAVENQATDRAFRIGQTRNVQVHKFVCTGTLEEKI
NAMMADKQQLAEQTVDAGENWLTRLDTDKLRQLLTLSATPVDYQAEASD

SEQ ID NO: 31, Anaebena variabilis ATCC 29413 Anava_SNF2 nucleic acid sequence

ATGGCAATTTTACACGGTAGTTGGATATTAAGTGAGCAGGATAGTTATTTATTTATTTGGGGGGAA
ACTTGGCGATCGCCACAAGTAAATTTTAGTTTTGAGGAAATAGCCCTCAATCCCTTGGCTCTGTCT
GCATCTGAATTAAGCGAGTGGTTGCAGTCTCAACATCAGGCGATCGCTCAGATTTTACCACAACAG
TTGGCAAAAAAAACCTCCAAAGCAGCAAGTTCCCCAACAACAAATTTACCAATTCACTCGCAAATA
ATTGTTCTGCCAACGGAAATTTCTCAACCTCGTAAGAAAGAAACAATTTTCATTTCTCCTGTGCAT
TCTGCCGCTTTAGAATCTGATGCAGACTCTGAAGTTTATTTACAACCTTGGCGTGTAGAAGGTTTT
TGTCTTCCTCCTAGTGCAGCAGTTAAATTTCTAACTTCTTTACCTTTAAATATCACTAGCACAGAG
AATGCTTTTTTAGGTGGAGATTTACGTTTTTGGTCACAAATTGCCCGTTGGAGTTTAGATTTAATT
TCTAGGTCTAAGTTTCTCCCAATTATCCAACGACAACCTAATAATTCTGTAAGTGCCAAATGGCAA
GTACTGTTAGATAGTGCTGTAGATGGAACTCGTTTAGAAAAGTTCGCCGCGAAGATGCCTTTGGTT
TGTCGGACTTATCAGAGATTAGGGAACGAGGAATTATCTCCATCTCCTATATATATAGATTTTCCT
AGTCAGCCGCAGGAATTAATATTGGGTTTTCTCAATAGTGCAATAGATACGCAATTACGGGAAATG
GTGGGGAATCAGCCTGTGGTGGAAACTCGCTTGATGGCATCTTTACCGTCGGCGGTACGACAGTGG
CTGCAAGGGTTAAGTGGTGCATCTAATTCAGTTGATGCAGATGCAGTTGGTTTGGAAAGGCTGGAA
GCAGCGCTCAAGGCTTGGACGATGCCGCTACAATATCAACTAGCAAGTAAAAATCAATTTCGCACC
TGTTTTGAATTACGTTCTCCAGAACCAGGAGAAACTGAATGGACACTAGCCTATTTCCTGCAAGCA
GCCGATAATCCAGAATTTCTAGTAGATGCGGGCACTATTTGGCAACATCCTGTTGAACAGCTAATT
TATCAACAGCGATCGATTCAAGAACCCCAGGAAACATTTTTACGAGGTTTGGGGTTAGCTTCTCGA
TTGTATCCGGTCATTGCCCCCACTTTAGATACAGAATCACCGCAATTTTGTCATCTCAACCCCATG
CAGGCTTATGAATTTATCAAGGCTGTGGCTTGGCGATTTGAAGATAGCGGTTTAGGGGTGATTTTA
CCTCCTAGTTTGGCGAACCGGGAAGGCTGGGCAAACCGCTTGGGATTGAAAATCTCCGCCGAAACC
CCAAAGAAAAAGCCAGGACGCTTGGGATTGCAGAGTTTGCTTAATTTTCAATGGCACTTAGCAATT

FIGURE 10 (continued)

GGTGGGCAAACTATTTCTAAAGGGGAATTTGACAGACTAGTAGCTTTAAAAAGCCCATTGGTAGAA
ATAAATGGCGAATGGGTGGAGTTGCGTCCCCAAGATATCAAGACAGCCGAAGCCTTTTTTGCTGCA
CGTAAAGACCAAATGGCCTTATCTTTAGAAGATGCTTTACGTCTGAGTAGTGGGGATACTCAAGTA
ATTGAGAAATTACCAGTAGTCAGCTTTGAAGCCTCTGGCGCATTACAAGAATTAATTGGGGCGCTG
ACAAATAATCAAGCAGTTGCACCATTACCTACGCCAAAGAACTTCCAAGGAAAGTTGCGTCCTTAT
CAAGAAAGGGGTGCGGCTTGGTTGGCATTCCTCGAACGCTGGGGTTTAGGTGCTTGTCTCGCCGAC
GACATGGGACTGGGAAAAACGATACAGTTCATTGCTTTCCTTCTCCATCTTAAAGAACAGGATGTA
TTAGAAAAACCAACTTTACTAGTGTGTCCTACTTCTGTTTTAGGTAACTGGGAACGAGAAGTGAAA
AAATTTGCACCTACACTTAAAGTTCTCCAATATCATGGTGATAAACGTCCTAAAGGTAAAGCTTTT
CCAGAAGCAGTAAAAAATCATGATTTAGTTATCACCAGTTACTCACTAATTCATAGAGACATCAAA
TCATTGCAGGGTCTTTCTTGGCAGATAATTGTTTTAGATGAAGCCCAGAATGTGAAGAATGCGGAA
GCCAAACAATCACAAGCAGTCCGACAATTAGACACAACCTTTCGCATTGCTTTAACGGGGACACCA
GTCGAAAATAGACTACAGGAACTTTGGTCAATTTTAGATTTCCTCAACCCTGGTTATTTAGGTAAT
AAGCAATTCTTCCAAAGACGCTTTGCCATGCCAATTGAAAAGTATGGTGATGCAGCATCTTTAAAT
CAATTGCGTGCCTTAGTACAACCATTTATTCTGCGTCGCCTGAAAACAGACCGTGATATTATTCAA
GACTTGCCAGATAAGCAAGAAATGACAGTATTTTGCGGTTTGACTGGAGAACAAGCTGCACTTTAT
CAAAAAGTGGTAGAAACATCTTTAGCAGAAATTGAATCGGCCGAAGGATTGCAACGCCGAGGGATG
ATTTTAGCTTTATTAATTAAACTCAAACAAATCTGCAATCATCCAGCCCAATATCTGAAAACAAAT
ACCTTAGAACAATACAGTTCAGGAAAACTGCAACGATTAGAAGAAATGTTAGAAGAGGTGTTAGCG
GAGAGTAATACTTATGGTGTTGCTGGTGCGGGACGTGCTTTAATCTTCACCCAGTTTGCAGAATGG
GGTAAGTTACTCAAACCACATTTAGAAAAACAACTAGGGCGGGAAGTATTTTTCTTATATGGTAGT
ACCAGTAAAAAGCAACGTGAAGAAATGATTGACCGTTTTCAACACGACCCTCAGGGGCCACCAATT
ATGATTCTCTCTCTCAAAGCAGGTGGTGTAGGGTTGAACTTAACCAGAGCAAATCATGTATTTCAC
TTTGATAGATGGTGGAATCCAGCCGTAGAGAACCAAGCCACAGACCGCGTATTTCGTATTGGTCAA
ACCCGCAATGTACAGGTGCATAAATTTGTTTGCAATGGTACCTTAGAAGAAAAAATCCACGACATG
ATTGAAAGTAAAAAACAACTAGCGGAACAGGTTGTTGGTGCAGGCGAAGAGTGGTTAACTGAATTA
GATACAGATCAACTCCGCAACTTACTGATACTTGATCGTAGTGCAGTAATTGATGAAGAAGCAGAG
TAA

SEQ ID NO: 32, Anaebena variabilis ATCC 29413 Anava_SNF2 translated polypeptide

MAILHGSWILSEQDSYLFIWGETWRSPQVNFSFEEIALNPLALSASELSEWLQSQHQAIAQILPQQ
LAKKTSKAASSPTTNLPIHSQIIVLPTEISQPRKKETIFISPVHSAALESDADSEVYLQPWRVEGF
CLPPSAAVKFLTSLPLNITSTENAFLGGDLRFWSQIARWSLDLISRSKFLPIIQRQPNNSVSAKWQ
VLLDSAVDGTRLEKFAAKMPLVCRTYQRLGNEELSPSPIYIDFPSQPQELILGFLNSAIDTQLREM
VGNQPVVETRLMASLPSAVRQWLQGLSGASNSVDADAVGLERLEAALKAWTMPLQYQLASKNQFRT
CFELRSPEPGETEWTLAYFLQAADNPEFLVDAGTIWQHPVEQLIYQQRSIQEPQETFLRGLGLASR
LYPVIAPTLDTESPQFCHLNPMQAYEFIKAVAWRFEDSGLGVILPPSLANREGWANRLGLKISAET
PKKKPGRLGLQSLLNFQWHLAIGGQTISKGEFDRLVALKSPLVEINGEWVELRPQDIKTAEAFFAA
RKDQMALSLEDALRLSSGDTQVIEKLPVVSFEASGALQELIGALTNNQAVAPLPTPKNFQGKLRPY
QERGAAWLAFLERWGLGACLADDMGLGKTIQFIAFLLHLKEQDVLEKPTLLVCPTSVLGNWEREVK
KFAPTLKVLQYHGDKRPKGKAFPEAVKNHDLVITSYSLIHRDIKSLQGLSWQIIVLDEAQNVKNAE
AKQSQAVRQLDTTFRIALTGTPVENRLQELWSILDFLNPGYLGNKQFFQRRFAMPIEKYGDAASLN
QLRALVQPFILRRLKTDRDIIQDLPDKQEMTVFCGLTGEQAALYQKVVETSLAEIESAEGLQRRGM
ILALLIKLKQICNHPAQYLKTNTLEQYSSGKLQRLEEMLEEVLAESNTYGVAGAGRALIFTQFAEW
GKLLKPHLEKQLGREVFFLYGSTSKKQREEMIDRFQHDPQGPPIMILSLKAGGVGLNLTRANHVFH
FDRWWNPAVENQATDRVFRIGQTRNVQVHKFVCNGTLEEKIHDMIESKKQLAEQVVGAGEEWLTEL
DTDQLRNLLILDRSAVIDEEAE

FIGURE 10 (continued)

SEQ ID NO: 33, uncultured methanogenic archaeon RC-I Archaeon_RC-I_SNF2 nucleic acid sequence

ATGATTACACTTCACGGAACCTGGACTACTGTCGATCCCCTGAATGGCACATTTTTCCTCTGGGGA
GAGAGTGATCCGGCCACGCAGCATAAAAGAAGAGGCAGGCCTCGGAAAAGTGCAGGGGAGAAACAG
CACCCGTTTCACGCCGGCATCAAAGAGCTGGAAGCTGGAGCGGGGGCTATCAATTCATCGTGTATA
AGACATATAGCAGATGCGGGAGCACGGGCGGAGCAGGTTTTAATTTTGCCGTCAGCTACGGACAGG
CCCCTGAGATCTGCGAGCCCTTCAGCACTGGAGTCAGGTGAAGAAACCAACCCTGACAGCAGTTTA
CAATTTCTTCCGTGGACGGTGACCGGCATCAACATTAAGCCCGGGAATGCTCTGGTACTTCTATCC
TCTATAGCCGAATCACAAAAGCGGATCGGAGATATGGCGATAGGCCCAGACCTGCTTTACTGGAGT
AAGGTAGCCAAGTTTACGCTTAAGCTCCTGATAAGCCAGCAGTTCAGGCCGGAGGTTGTCGAAGTA
ATGAGCGGAAAAGCATATAGCCGTTGGAGATTTGCGCTCACCGATGAAACTGACCGGAAACACTAT
GCCTCGCTCGAAAACTCCATGCCGCTGGCATGTATTGCGGTTTCAGGAAAGGCTGGCATTTATAAT
CGAAAAGAAGCCTTAGATTTGTTCATTAATACCGCCCTTGACACATTTATCCGGGACCAGATTGCC
CTGCCCGCTGACAGCAGGATGACGAACCTGCTATCGCAAGCATGGCTAGATTCGCTCGGCACCGGA
GAGAGTATCCGCCTGTCGGCTCCTGAGATGAAGAAACTCAAAGATTCGGCAGGCCGCTGGACATCC
CGCATGAAAACAGAGAGCAAACAAGCTTTAAAGACCTGCTTCATCCTGGAGCCGCCAGCCCCGGAT
ACAGAGTATCCTGAAGCGCCGTGGAACCTACGGTACTGCTTGCAGGCATCCGATGACCCCAGTCTG
GTAATTCCGGCTGAGACTGTGTGGAAAGAGTTGAAGAAGACGCTGAAGTACCTGAATAAGAGATAC
GATAACCCTCAGGAGCAATTGTTACAGGATCTCGGAAAAGCGATGCAGATGTTTCCCGAAATCGAG
CCCAGCCTCAACACGTCAAAACCTCTGTCCGCAACGCTGAGCACCAGTGAAGCCTACAAGTTCCTG
ACAGAAGCGGCGCCTCTGCTGCAGGACAGCGGGTATAGCATTATCCTACCGGAATGGTGGCGCAAC
AGCACTGGCAGGCTCAAGCTCGGCGCCAGGCTTCGCTTCAAGCCGAAAGCCGAAGGTAAAGCGGGT
AAAAGCCAGTTCACCATGGATACCCTCGTCAGCTACGACTGGCGCCTGGCGCTGGGCGATCAGGAG
ATCACCGAAACAGAGTTCAGGAAGCTGGCAGCCCTGAAAGAGCCGCTTCTGCAGATAGGCGGGAAA
TGGTTTGCGCTGAAAAAGGAAGACATAGACAGCATCATGAAAGCATTCAGGGCGAAGAAGACTGGA
GAGATGGCTTTATCGGAGGCACTGCGCCTCAACGGCGGGCTGGAAGACTTCAACGGCATCCCCGTC
AGCGGCATGAAATCGTCAGGATGGCTGGCAGAACTTTTCGACAGGCTGGCAGCCGGCGAAAAAATA
ACGAGCCTTGCCCCGCCGGACGGTTTCAACGGGGAGCTTAGAGATTACCAGGTTAAAGGCTACTCC
TGGCTGGCCTTCATGAAAAAGTATGGCCTGGGCTCCATTCTGGCTGACGACATGGGCCTGGGTAAG
ACGATACAGCTGCTGGCGTTGCTCCTGAAAGAGAAGGAAAGAGGCACTAAAGGCCCTACTCTGTTG
ATCTGCCCCACCTCGATTCTCGGAAACTGGCAGCGGGAGGCGAAGAAATTTGCCCCGGCCCTGAAA
GTCCACATACACCATGGGGCAGGAAGGGCTGATAAAGAGCAGTTCGGAAAAATCGTCAAGGCTCAC
GACCTGATCCTGAGCACTTACGCTCACGCCTACCGGGACGAGGAACTGCTTAAAGAGGTGAACTGG
AAGCTGGTAGTGCTCGACGAGGCTCAGAATATCAAGAATCATCATACCCGGCAGGCCAGAGCTATC
CGGGCTCTTAAGGCCGATCACCGAATAGCCATGACGGGAACGCCGATAGAGAACAGACTCTCGGAG
CTGTGGTCGATCGTGGACTTCCTGAACCCCGGCTACCTGGGCAAGGCGGAGACATTCAGGAAACAA
TTCGCCATACCTATCGAGAGATACGATGACGCTGCCCGGTCGGAAAAATTGAAGCAGGCCATCAAG
CCCCTGGTGCTGCGCAGAGTGAAGACGGATCCGGCCATCATCAAAGACCTGCCGGACAAGATCGAG
ATCAAGGAGCCCTGCAACCTCACCAAAGAACAGGCCACGCTCTACGAGGCCATCGTAGAGAACATG
CTGAAAAGTATAGATAAGGCCACGGCAATGCAGAGACGGGGAATCGTCTTAGCGTCCCTGATGAAG
CTCAAACAGGTCTGCGATCACCCGTCGCTGTACATCAAAACGGGCGCTGTGACCGACGATAAGACG
CTGATCAGGTCTGGCAAGCTGAAGCGCCTCACGGAGCTGCTCGAAGAAGCGCTGGCCGAAGGCGAC
AGCGTGCTGATCTTCACCCAGTTCGTGGAAATGGGGGAGATGCTGAAAGCCTACCTGCAGAGCACG
TTCGACGAAGAAGCCCTCTTTTTGCACGGCGGAGTACCGCAGAAGGCCAGAGACAAGATGGTCCTC
CGTTTCGGGGAAAAGGACGGGCCACGGATCTTTATCGTCTCGCTGAAAGCCGGCGGCGTCGGCCTC
AACCTGACGAAGGCAAGCCACGTGTTCCACTTCGATCGCTGGTGGAACCCGGCGGTCGAGAACCAG
GCGACAGATCGAGCTTACAGGATAGGCCAGAGCAAAAATGTACTGGTCCATAAATTCGTCTGCGCC
GGCACGCTGGAAGAAAAGATCGACGAGCTGATCGAGAGCAAAAAGGCGCTGTCGGCGAACATCCTC
GGCACGGGAGAAGACTGGATCACGGAGTTGTCGACCGAACAGCTGAGGGACATGGTCATGCTGAGA
TGGGACGAGGTAGCCGATGATGGCTAA

FIGURE 10 (continued)

SEQ ID NO: 34, uncultured methanogenic archaeon RC-I Archaeon_RC-I_SNF2 translated polypeptide

MITLHGTWTTVDPLNGTFFLWGESDPATQHKRRGRPRKSAGEKQHPFHAGIKELEAGAGAINSSCI
RHIADAGARAEQVLILPSATDRPLRSASPSALESGEETNPDSSLQFLPWTVTGINIKPGNALVLLS
SIAESQKRIGDMAIGPDLLYWSKVAKFTLKLLISQQFRPEVVEVMSGKAYSRWRFALTDETDRKHY
ASLENSMPLACIAVSGKAGIYNRKEALDLFINTALDTFIRDQIALPADSRMTNLLSQAWLDSLGTG
ESIRLSAPEMKKLKDSAGRWTSRMKTESKQALKTCFILEPPAPDTEYPEAPWNLRYCLQASDDPSL
VIPAETVWKELKKTLKYLNKRYDNPQEQLLQDLGKAMQMFPEIEPSLNTSKPLSATLSTSEAYKFL
TEAAPLLQDSGYSIILPEWWRNSTGRLKLGARLRFKPKAEGKAGKSQFTMDTLVSYDWRLALGDQE
ITETEFRKLAALKEPLLQIGGKWFALKKEDIDSIMKAFRAKKTGEMALSEALRLNGGLEDFNGIPV
SGMKSSGWLAELFDRLAAGEKITSLAPPDGFNGELRDYQVKGYSWLAFMKKYGLGSILADDMGLGK
TIQLLALLLKEKERGTKGPTLLICPTSILGNWQREAKKFAPALKVHIHHGAGRADKEQFGKIVKAH
DLILSTYAHAYRDEELLKEVNWKLVVLDEAQNIKNHHTRQARAIRALKADHRIAMTGTPIENRLSE
LWSIVDFLNPGYLGKAETFRKQFAIPIERYDDAARSEKLKQAIKPLVLRRVKTDPAIIKDLPDKIE
IKEPCNLTKEQATLYEAIVENMLKSIDKATAMQRRGIVLASLMKLKQVCDHPSLYIKTGAVTDDKT
LIRSGKLKRLTELLEEALAEGDSVLIFTQFVEMGEMLKAYLQSTFDEEALFLHGGVPQKARDKMVL
RFGEKDGPRIFIVSLKAGGVGLNLTKASHVFHFDRWWNPAVENQATDRAYRIGQSKNVLVHKFVCA
GTLEEKIDELIESKKALSANILGTGEDWITELSTEQLRDMVMLRWDEVADDG

SEQ ID NO: 35, Bacillus cereus ATCC 10987 Bacce_ATCC10987_SNF2 nucleic acid sequence

ATGATCAATCAAACTGAAGTAACAATTAGGCTCCAGCACGTTAGTCACGGTTGGTTCCTTTGGGGA
GAAGATGATAGCGGTACTCCATTATCCGTAACAAGTTGGAAACGAAATGCATTTACATGGCACTCC
ACTTCCTTCTACGGCACGTTTCTAAAAGAAGCAAGCTTTGAAGGAAGACAAGGTGTTATGCTAACA
AACGCACAAGCATTTGAATACATCGCGAATAAACCGATGAACTCCTTTGCCCGTATTCAAATGAAC
GGCCCTATTACAGCACTTACGGAAGATGCGAACGAATTGTGGGATGCCTTCACAAGCGGTAGCTTC
GTACCTGATATGGAGCGTTGGCCTAAACAACCATCTTGGAAAGTTCAAAATACTCCAATCGAAGAT
GAAACATTGGCATCTCTTTTCTCGGCTGCAGTAAATGAAAGCATATTACAAGATAACCGTTCAAAT
GACGGATGGGAAGATGCAAAGAGACTTTATGAACATTACGACTTTACGAAAAGACAATTAGACGCA
GCACTACATGAAGAAGATTGGCTTCGAAAAATTGGTTACATTGAAGATGACCTTCCCTTTACAATC
GGACTACGACTACAAGAGCCGCAAGAAGAATTTGAAATGTGGAAGCTTGAAACAATTGTTACGCCA
AAGCGCGGGGCACATCGCATATATGTATATGAGAGTATCGATTCTTTACCAAAACGATGGCACGAT
TATGAAGAACGTATTCTGGAAACACAAGAAAGCTTCAGTAAGCTCGTACCGTGGCTAAAAGATGGT
GATACATTCCGAAGTGAACTCTTTGAAACAGAAGCGTGGAACTTCTTAACAGAAGCAAGTAACGAA
TTACTCGCCGCAGGTATTACAATCTTATTACCATCGTGGTGGCAAAATTTAAAAGCGACAAAACCA
AAATTACGTGTGCAACTGAAGCAAAATGCTACACAAACGCAATCTTTCTTCGGCATGAATACACTC
GTTAATTTTGACTGGCGCATTTCAACGAACGGCATTGATTTATCAGAAAGCGAATTTTTTGAACTC
GTTGAACAAAACAAGCGGTTATTCAATATAAATGGTCAATGGATGCGACTAGATCCAGCCTTTATT
GAAGAAGTACGAAAGCTCATGAATCGTGCTGATAAGTATGGACTTGAAATGAAAGATGTCCTGCAG
CAACATTTATCAAACACGGCTGAAACAGAAATTGTAGAAGAGGATAGTCCGTTTACAGATATTGAA
ATTGAACTAGATGGATATTATGAAGACTTATTCCAAAAACTATTGCACATTGGAGATATTCCGAAA
GTAGATGTCCCTTCATCACTAAACGCCACACTCCGTCCGTATCAACAACATGGCATTGAGTGGTTA
TTATATTTAAGAAAGCTTGGATTCGGCGCATTGTTAGCTGACGACATGGGACTTGGAAAGAGTATT
CAAACGATCACTTACTTACTATATATAAAAGAAAACAATCTCCAAACAGGTCCTGCTTTAATCGTG
GCTCCGACATCTGTTCTTGGAAATTGGCAAAAAGAATTTGAGCGTTTCGCACCGAATTTACGTGTT
CAGTTACATTATGGAAGTAACCGAGCTAAAGGGGAACCCTTTAAAGATTTCCTTCAATCAGCAGAT
GTTGTATTAACATCTTATGCATTAGCTCAGCTTGATGAGGAAGAACTTAGTACGTTATGCTGGGAT
GCTGTTATTTTGGATGAAGCACAAAATATTAAAAACCCACATACGAAACAGTCTAAAGCAGTACGA

FIGURE 10 (continued)

AACTTACAAGCAAATCACAAAATCGCATTAACTGGGACACCGATGGAAAACCGCCTTGCCGAGCTT
TGGTCTATTTTCGACTTCATTAATCATGGATATCTTGGCAGCTTAGGACAATTCCAGCGCCGCTTC
GTCTCACCAATTGAAAAGGACCGTGACGAAGGAAAAATCCAACAAGTTCAACGTTTTATCTCACCG
TTTTTACTGCGTCGTACGAAGAAAGATCAAACAGTCGCATTAAACTTACCAGATAAACAAGAACAG
AAAGCTTACTGTCCACTAACTGGTGAACAAGCTTCCTTATATGAACAACTTGTTCAAGATACGTTG
CAAAATGTAGAAGGATTAAGCGGAATTGAACGACGCGGATTTATATTACTCATGCTGAACAAACTT
AAACAAATTTGTAATCATCCCGCTCTTTATTTAAAAGAAACAGAACCGAAAGACATCATCGAGCGT
TCCATGAAAACGAGCACGCTCATGGAACTCATTGAAAATATAAAAGATCAAAATGAAAGTTGCTTA
ATCTTCACGCAATACATCGGTATGGGGAACATGCTAAAAGATGTGTTAGAAGAACATTTCGGTCAG
CGCGTCCTCTTCTTAAACGGTAGTGTACCGAAGAAAGAACGTGACAAAATGATCGAACAGTTCCAA
AACGGAACGTATGACATCTTCATTTTATCGTTAAAAGCAGGTGGTACAGGATTAAACTTAACAGCT
GCCAACCATGTCATTCACTACGATCGTTGGTGGAATCCAGCGGTAGAAAACCAAGCAACAGACCGT
GCATATCGCATTGGTCAAAAGCGCTTCGTTCACGTTCATAAACTGATTACAACGGGGACACTTGAA
GAGAAAATCGATGAAATGTTAGAAAGAAAACAATCATTAAACAACGCCGTCATTACAAGCGATAGT
TGGATGACAGAACTATCTACAGATGAACTAAAAGAATTACTTGGTGTATAA

SEQ ID NO: 36, Bacillus cereus ATCC 10987 Bacce_ATCC10987_SNF2 translated polypeptide

MINQTEVTIRLQHVSHGWFLWGEDDSGTPLSVTSWKRNAFTWHSTSFYGTFLKEASFEGRQGVMLT
NAQAFEYIANKPMNSFARIQMNGPITALTEDANELWDAFTSGSFVPDMERWPKQPSWKVQNTPIED
ETLASLFSAAVNESILQDNRSNDGWEDAKRLYEHYDFTKRQLDAALHEEDWLRKIGYIEDDLPFTI
GLRLQEPQEEFEMWKLETIVTPKRGAHRIYVYESIDSLPKRWHDYEERILETQESFSKLVPWLKDG
DTFRSELFETEAWNFLTEASNELLAAGITILLPSWWQNLKATKPKLRVQLKQNATQTQSFFGMNTL
VNFDWRISTNGIDLSESEFFELVEQNKRLFNINGQWMRLDPAFIEEVRKLMNRADKYGLEMKDVLQ
QHLSNTAETEIVEEDSPFTDIEIELDGYYEDLFQKLLHIGDIPKVDVPSSLNATLRPYQQHGIEWL
LYLRKLGFGALLADDMGLGKSIQTITYLLYIKENNLQTGPALIVAPTSVLGNWQKEFERFAPNLRV
QLHYGSNRAKGEPFKDFLQSADVVLTSYALAQLDEEELSTLCWDAVILDEAQNIKNPHTKQSKAVR
NLQANHKIALTGTPMENRLAELWSIFDFINHGYLGSLGQFQRRFVSPIEKDRDEGKIQQVQRFISP
FLLRRTKKDQTVALNLPDKQEQKAYCPLTGEQASLYEQLVQDTLQNVEGLSGIERRGFILLMLNKL
KQICNHPALYLKETEPKDIIERSMKTSTLMELIENIKDQNESCLIFTQYIGMGNMLKDVLEEHFGQ
RVLFLNGSVPKKERDKMIEQFQNGTYDIFILSLKAGGTGLNLTAANHVIHYDRWWNPAVENQATDR
AYRIGQKRFVHVHKLITTGTLEEKIDEMLERKQSLNNAVITSDSWMTELSTDELKELLGV

SEQ ID NO: 37, Crocosphaera watsonii WH 8501 ctg336 Crowa_SNF2 nucleic acid sequence

ATGACAATATTACATGGAACTTGGATTGAAAATACCTCTGAAAAACATTTTTTTATTTGGGGGGAA
ACTTGGCGTTCTTTATCCTCTGATATTTCCTCAGATGATTCTATTTTAATGTATCCATTTTCTGTA
GATAAACAGGGAATTATTGAACAATTAAACTCGAATAAGATTAAGATTGAAAAAAACAAAAATATT
GAATCTGTTTCTCAAATATTTTATTTGCCTAGTAAATTTATTGCTAAATCGAAGCAAAGTATCCCT
TTACTATCAACAGAATTAAAAGATAAAGATTTTGAACAAGGGGATATTCAGTTAATTGCTTGGAAA
ATCGAAGGGATAAAATTAAATGTTGATGATACAATTAATATTTTAAGTCAGTTACCGTTGGGATTA
ACCAATAATGACGAAAATTACATAGGCGATAATTTAAAATTTTGGACACATATTTATCGTTGGAGT
CTAGATTTATTAACTAGAGGTAAATATTTACCGCAAATGGAAGAACAAGATAATAACTGTTATGGA
CAATGGGAACCTTTACTAGATAGTTTAGTTGATCAGCAACGGTTCTCTAAATTTATACAAACTATG
CCAAATAGTTCTCTTGCTTATCATAATTTAATGGAGGGTGAATTATCCTCTTCTTTACTCAAACAA
ACTACTATTCTTGATTTTTTATCTACTATCATTAATCAACAAGTACGTCAATTTATTGATGTTGCT
ATTACCCCTAGTTCATTTATCCAAAAGTGGTTATACTCTTTAACACAAGACTTATCTAAATTTGAA
GCATCAGAAGTTGAAAGAAAGGGATTAAAGAATGCTATTAATAATTGGAAATCTTCTTTAAGTGAA

FIGURE 10 (continued)

TATATTATAAAGTCTGATAATCAACCATTAGGAATTAACCAGTTTCGTGTTTGTTTTAAACTAGAA
AATCCAGCTAAAAGTGGTAAGAAATTAGAACAAAGTAATTGGCAGTTACACTACTATCTCCAAGCT
TTAGATGATCCTAATTTTCTGATCTCTGCCAAGGTTATTTGGGAAAATCCTGTTACTAGATTAATC
TGCAATAATAGAACAATTAATCATCCTCAAGAAACCTTGCTAAAAGGACTAGGTTTAGCTTCACGT
CTATATTATCTAATTGAAGAAAGTTTACAAGACAATAAGCCTAGTTTTTCTGAGTTAGATCCCATA
CAAGTCTATGAATTTTTACGTTCAATTGCTAATATTCTTAAAGATAATGGCTTAGGGGTTATCTTA
CCAGCTAGTCTAGAGCAAGGAGTCGAAGAAAAACGCTTAGGAATTAGTCTAACCGCAGAAGTTAAG
TCGAAAAAAGGACAAAGACTTAGCTTACAAAGTTTGTTAAGTTATAAGCTAAATTTAGCAATTGGT
GATAAAACAATATCGAAAAAAGACTTTGAAAAACTATTAGCGCAAAAGTCACCTTTAGTTGAAGTA
AAAGGAGAATGGATAGCATTACAACCTGCTGATGTCAAGGCCGCACAACAAATTTTAAATAAGTCC
TATGATCCCCTAGAACTTTCTGTAGAAGATGCTTTACGCTTCAGCACAGGAGATATTTCAACTGTT
GCCAAACTGCCGATTACTAACTTTGAAGCAAAAGGGGAATTAGCCAATCTAATTAATGCTATAAAT
AATAATGAATCAATCCCTATGATCGAAAATCCCAGAGGATTTAAAGGTCAATTACGTCCCTATCAA
CAGCGAGGAGTCGGTTGGTTATCGTTCTTAGAAAAATGGGGTTTAGGGGCTTGTCTTGCCGATGAT
ATGGGATTAGGAAAAACACCACAATTAATTGGGTTTCTCTTACATTTAAGAAGCGAAGGAATGTTA
GATCAACCTACCTTAGTTATTTGTCCTACATCTGTTTTAAATAACTGGGAAAGAGAAGTTCAAAAA
TTTGCCCCAACCCTTTCTACTTTGATTCATCATGGAGATAAACGTAGTAAAGGGAAAGCTTTTGTT
AAAGCAGTTAGTAAAAAAAATGTTATCATTACTAGCTATTCTTTAATTTATCGAGATATTAAAAGC
TTTGAACAGGTAGAATGGCAAGGTATTGTCTTAGATGAAGCACAAAATATAAAAAATCCCCAGGCA
AAACAATCCCAAGCAGTGCGTCAAATTTCCACACAGTTTCGTATTGCTTTAACAGGAACTCCTGTA
GAAAATCGCCTAACAGAATTATGGTCAATTCTTGACTTTCTTAACCCAGGATTTTTAGGGACACAG
CAGTTTTTCCGTCGTCGTTTTGCCACTCCTATCGAAAAATATGGGGATAAAGAATCACTGCAAATT
ATGCGTTCTTTGGTACGTCCTTTCATTCTCAGACGATTGAAAACAGATAAAACTATTATTCAAGAT
TTACCCGAAAAACAAGAAATGACCATTTTTTGTGGGTTATCCTCAGAACAAGGAAAACTTTATCAA
CAATTAGTAGATAATTCTCTGGTAGCAATAGAAGAGAAAACAGGAATTGAACGCAAAGGCTTAATT
TTAAGCTTACTGCTAAAACTCAAACAAATTTGTAACCATCCTGCTCATTTTCTCAAGCAAAAGAGC
TTAAAAACAGCAGAACAATCTGGTAAATTATTAAGACTAGAAGAAATGCTAGAAGAATTAATCGAA
GAAGGAGATCATGCTTTAATCTTTACCCAATTTTCTGAATGGGGTAAACTGCTGCAACCTTATTTA
CAGAAAAAATTTCAGCAAGACGTTCTCTTTTTGTATGGTGCTACTCGCAGAGTTCAAAGACAAGAA
ATGATCGATCGCTTTCAACAGGATCCCAACGGACCCAGAATTTTTATTCTCTCCTTAAAAGCAGGG
GGAACCGGATTAAATTTAACCCGCGCTAACCATGTATTTCATATTGATCGTTGGTGGAACCCAGCA
GTAGAAAATCAAGCAACCGATCGCGCGTTTCGTTTAGGACAAAAACGCAATGTTCAAGTACATAAA
TTTGTCTGTACAGGAACCCTAGAAGAAAAAATTAACGAAATGTTAGAAAGTAAACAAAAATTAGCC
GAACAAACCGTTGACGCAGGGGAACAATGGTTGACAGAATTAGATACAGATCAACTGCGTAACCTC
TTATTATTGGATCGAGATACCATTATTGACGAACAATAA

SEQ ID NO: 38, Crocosphaera watsonii WH 8501 ctg336 Crowa_SNF2 translated polypeptide

MTILHGTWIENTSEKHFFIWGETWRSLSSDISSDDSILMYPFSVDKQGIIEQLNSNKIKIEKNKNI
ESVSQIFYLPSKFIAKSKQSIPLLSTELKDKDFEQGDIQLIAWKIEGIKLNVDDTINILSQLPLGL
TNNDENYIGDNLKFWTHIYRWSLDLLTRGKYLPQMEEQDNNCYGQWEPLLDSLVDQQRFSKFIQTM
PNSSLAYHNLMEGELSSSLLKQTTILDFLSTIINQQVRQFIDVAITPSSFIQKWLYSLTQDLSKFE
ASEVERKGLKNAINNWKSSLSEYIIKSDNQPLGINQFRVCFKLENPAKSGKKLEQSNWQLHYYLQA
LDDPNFLISAKVIWENPVTRLICNNRTINHPQETLLKGLGLASRLYYLIEESLQDNKPSFSELDPI
QVYEFLRSIANILKDNGLGVILPASLEQGVEEKRLGISLTAEVKSKKGQRLSLQSLLSYKLNLAIG
DKTISKKDFEKLLAQKSPLVEVKGEWIALQPADVKAAQQILNKSYDPLELSVEDALRFSTGDISTV
AKLPITNFEAKGELANLINAINNNESIPMIENPRGFKGQLRPYQQRGVGWLSFLEKWGLGACLADD
MGLGKTPQLIGFLLHLRSEGMLDQPTLVICPTSVLNNWEREVQKFAPTLSTLIHHGDKRSKGKAFV

FIGURE 10 (continued)

KAVSKKNVIITSYSLIYRDIKSFEQVEWQGIVLDEAQNIKNPQAKQSQAVRQISTQFRIALTGTPV
ENRLTELWSILDFLNPGFLGTQQFFRRRFATPIEKYGDKESLQIMRSLVRPFILRRLKTDKTIIQD
LPEKQEMTIFCGLSSEQGKLYQQLVDNSLVAIEEKTGIERKGLILSLLLKLKQICNHPAHFLKQKS
LKTAEQSGKLLRLEEMLEELIEEGDHALIFTQFSEWGKLLQPYLQKKFQQDVLFLYGATRRVQRQE
MIDRFQQDPNGPRIFILSLKAGGTGLNLTRANHVFHIDRWWNPAVENQATDRAFRLGQKRNVQVHK
FVCTGTLEEKINEMLESKQKLAEQTVDAGEQWLTELDTDQLRNLLLLDRDTIIDEQ

SEQ ID NO: 39, Gloeobacter violaceus PCC 7421 Glovi_SNF2 nucleic acid sequence

ATGGCTATCTTGCACGGTATCTGGGTTCACCAACCCCCCCGGGCCGGGCTTTTCCTTTGGGGAGAA
ACCTGGAGGCAGGTCGCAAAGCGGCGCAAGCGCTCCGAAGCACCCGCTCCGCATCCCTATGTCCAG
CAACCGGCCGAGTTGTCCCCCCGCCTGGCTGCCCAGTTTCCCCAGATACCGCTCAGCTTGCTGGTA
CCCGAGACGCTTGCACTCCAGTTGCCCGCCACGGTCGAAAACGTGGTCTACTCCGCAAGCATTGCT
CCCGAGGGCAAGCTTTTGGAGTTGGAACCGTGGCTGGTGGAAGGTTTCTGGCTCGACGGTCACCAG
GCTTTTGAACTGTTGCTCGGGGTACCCCTGGGCGGCGGGGACGCATCGATTGGCGACGACCTGCGC
TTCTGGTCGCAGTGCGCCCGCTGGGTGCTTGACTTGCTGGTGCGCGCCAAGTACCTGCCCGACCTG
GAGAGCGGCGACGGCCAGGAAATCCCCACAGCCCGCTGGGTGCCCCTGCTCGACAGCGCCGTCGAT
CAAGCCCGCCTCAAAGAATTTGCCGCCCGTTTGCCGGGCGCCTGCCGCGCCGCTACCCCCGAACTA
TCTCCGCACCAGATTCTCAAGAGTTTCCTGAGCGCCATGCTCGACGCGCGGGTGCGCACGCTGCTC
GCTTGCGAGCCTCCCGATCCGCGCACGCTGCCTGCCGGAGCGGTGCGCCCCTGGCTTCTGGCCCTG
GCCCATGCCCAGCCCCAGCTCAAATCTCCGGACCCGGAGACGCCGGCTCTGGCGGAAGCCCTGGCC
ACCTGGCGCGCCCCCCTGAGCTATCAGGTTCGCTCGCGCACCTGCTTCCGTCTGCAGCCGCCCGAG
GAGAGCCAGGGCGAGTGGAAGCTGCACTTTCTATTGCAAACAGGCGACGATCCCGATTCGCTGATG
GCTGCCCAGCAAGTCTGGAGCAGCGCGGGTGAGCTGCAGGAGGTGTTTCTCGCGGGCTTGGGCCTC
GCCTCGCGTATCTTTGTGCCCGTCGAGCGGGGATTGCTCGTCCCCCAGCCCACCTGCTGCACCATG
AGCACCGTCGAGGCGTTTCAGTTTCTCAAAGCCGCCACCTGGCGGTTGCGCGACAGCGGCTTCGGG
GTGTTGTTGCCCGAGAGCCTCGCGGACGCGGGCAGCCTGCGCAACCGCCTGGGCCTCAAACTCGAA
GCGAACGCGCCGGGGCGCAACGGTTCGGGCCTCGGCATGCAGAGCTTGCTCGCTTTTAAATGGGAG
CTGTCGCTCGCGGGCAAGACCCTGAGCCGCGCCGAGTTCGACCGCCTCGCCGCTAGTTCTGAACCC
CTGGTCAAAGTCAACGACAACTGGGTCGAATTGCGCCCCCAGGACGTGCGCGCCGCCCACAGCTTT
TTGCAGTCGCGCAAAGATCAGGTCGGACTCTCGTTGGAGGATGTGCTGCGCCTCAACTTCGGCGAC
ACCCCCAAAATCGACGGTCTCCCCATCGTCAACTTCGACAGCTCCGGCCCCATTCAGCAACTGCTG
GAGACCCTCACCGATCAGCGCAAACTCACCCCCATCGACGAACCGCCGGGGTTCAAGGGCACCCTG
CGGCCCTATCAAAAATTGGCGTCGGCTGGCTCGCCTTTTTGCAGAAGTGGGGCCTGGGTGCTTGC
CTAGCCGACGACATGGGACTCGGGAAGACCGTAGAGTTGATAGCATTTCTTCTTTTTTCTCAAATCC
AAAAATGAGCTGGACGGCCCTATATTGTTAATTTGTCCGACTTCAGTGATGGGAAACTGGGAAAGA
GAAATAAAGAAATTTTCTCCTAGTTTATCTGTACATGTCCATCATGGGGCGCGGCGGCCGAAGGGG
CGCAATTTTGTCGAGACGGCCCAGAAAAAGCAAATCATCGTCAGCAGCTACGCCCTGGTACAGCGC
GACAGCAAAGATCTCAAGCGCGTCGAATGGTTGGGCCTGGTGCTCGACGAAGCCCAGAACATCAAA
AACCCCGACGCCAAGCAGACCCAGTCGATTCGGGAACTGACAGCGCGCTTTCGCATCGCCCTCACC
GGCACACCGGTCGAGAATCGCCTCGCGGAACTGTGGTCGATCCTCGATTTTCTCAATCCCGGCTAT
CTGGGGGCGCGCAACTTCTTTCAGCGCCGCTTCGCAGTTCCGATCGAAAAGTACGGGGATCGCTCC
TCGGCGAACGCCCTCAAAGCTCTGGTGCAGCCGTTTATCCTGCGGCGGCTCAAATCCGACCCGCAG
ATTATTCAAGATCTGCCCGAGAAGCAGGAGACGAATGTCTTCTGTCCGCTCACACCCGAGCAGGCG
GCCCTCTACGAGCGGGTGGTGAACGAATCGCTCGCCAAGATCGAGCAGAGCACCGGCATCCAGCGG
CGCGGGACGGTGCTGGCCACCTTGGTCAAACTCAAGCAGATCTGCAACCACCCGAGCCACTACCTG
GGTGACGACGGACCGCTCGCCAACCGCTCGGGCAAACTCAGCCGCCTGGGCGAGATGCTCGAAGAA
GTGCTCGCCGACGAGGAGCGGGCGCTGATTTTTACCCAGTTCGCCGAGTGGGGCCACCTGCTGCAG

FIGURE 10 (continued)

GCGCACCTGAGCCGCCAGTTGGGTTCAGAAGTGTTTTTCCTCTACGGCGGCACCAGCAAAAACCAG
CGCGAGGCGATGATCGAGCGCTTCCAGAGCGATCCGCAGGGGCCGCGGATTTTTATTCTTTCGCTG
AAGGCAGGGGGTGTCGGCCTCAACCTCACCCGCGCCAACCACGTCTTCCACTTCGACCGCTGGTGG
AACCCGGCGGTCGAGAATCAGGCCACCGACCGCGTCTTCCGCATCGGCCAAACCAAGAACGTACAA
GTCTACAAGTACGTGTGCACCGGCACGCTCGAAGAGCGCATCAACGCCCTGATCGAAAGCAAAAAG
GCCCTGGCTGAGCAGGTGGTGAGCGCCGGTGAGAACTGGCTGTCGGATCTAAATACCGATCAACTG
CGGCAACTGTTGGTACTCGATCGCTCGGAGATTATCGACACGGAGGACACCGCGTGA

SEQ ID NO: 40, Gloeobacter violaceus PCC 7421 Glovi_SNF2 translated polypeptide

MAILHGIWVHQPPRAGLFLWGETWRQVAKRRKRSEAPAPHPYVQQPAELSPRLAAQFPQIPLSLLV
PETLALQLPATVENVVYSASIAPEGKLLELEPWLVEGFWLDGHQAFELLLGVPLGGGDASIGDDLR
FWSQCARWVLDLLVRAKYLPDLESGDGQEIPTARWVPLLDSAVDQARLKEFAARLPGACRAATPEL
SPHQILKSFLSAMLDARVRTLLACEPPDPRTLPAGAVRPWLLALAHAQPQLKSPDPETPALAEALA
TWRAPLSYQVRSRTCFRLQPPEESQGEWKLHFLLQTGDDPDSLMAAQQVWSSAGELQEVFLAGLGL
ASRIFVPVERGLLVPQPTCCTMSTVEAFQFLKAATWRLRDSGFGVLLPESLADAGSLRNRLGLKLE
ANAPGRNGSGLGMQSLLAFKWELSLAGKTLSRAEFDRLAASSEPLVKVNDNWVELRPQDVRAAHSF
LQSRKDQVGLSLEDVLRLNFGDTPKIDGLPIVNFDSSGPIQQLLETLTDQRKLTPIDEPPGFKGTL
RPYQKIGVGWLAFLQKWGLGACLADDMGLGKTVELIAFLLFLKSKNELDGPILLICPTSVMGNWER
EIKKFSPSLSVHVHHGARRPKGRNFVETAQKKQIIVSSYALVQRDSKDLKRVEWLGLVLDEAQNIK
NPDAKQTQSIRELTARFRIALTGTPVENRLAELWSILDFLNPGYLGARNFFQRRFAVPIEKYGDRS
SANALKALVQPFILRRLKSDPQIIQDLPEKQETNVFCPLTPEQAALYERVVNESLAKIEQSTGIQR
RGTVLATLVKLKQICNHPSHYLGDDGPLANRSGKLSRLGEMLEEVLADEERALIFTQFAEWGHLLQ
AHLSRQLGSEVFFLYGGTSKNQREAMIERFQSDPQGPRIFILSLKAGGVGLNLTRANHVFHFDRWW
NPAVENQATDRVFRIGQTKNVQVYKYVCTGTLEERINALIESKKALAEQVVSAGENWLSDLNTDQL
RQLLVLDRSEIIDTEDTA

SEQ ID NO: 41, Lyngbya sp. PCC 8106 Lyn_sp_SNF2 nucleic acid sequence

ATGGCAATTTTACACGGAAGTTGGCTCCAGCACCCCAAAAATTATTTGTTTATTTGGGGAGAAACC
TGGCGTCGCATTACACCCAATGAATTTAATCCGGCTGATGGTGTTTTGGGTTATCCTTTTGCTTTA
AGCCCTGTTGAATTGGAAAAGTGGTGCAGTGAAAAGCAGTTATCTATAGAGAGTAAAGTTGTCGTT
ACAGAAACTCTCGCCCTTCCCACTAAACTCTCCCCAAAAATAGGACTATATCCCCTTCAATCTACG
CCTCAAACTGATTCTGAAACTGATTCTGAGTCGATCTGTCTTTATCCCTGGAAAATTGAAGGTATT
TGTCTCAACAGTACAGAAGCCTTTGACTTTTTACAATCCCTTCCTCTGGGAAACCTGACCACAGAA
AACTCATTTATTGGCTCAGATTTACAGTTTTGGTCTCATCTTTCCCGTTGGAGTTTAGACTTACTC
GCCCGGAGTAAATTTTTACCCAGTCTCACTTTTAACCCCTCAAAAGATCACTTTATCGCTGAATGG
AAACCTTTACTCGATAGTGCGACAGATCAAGCCAGATTAATTCGTTTTTCTAAACAAATACCCTCT
GCTTGTCGGATCTATCAACTCTGGTCAAAAGAGGCTCAAAATCAATTTGAAAATTTAGCCCTAGAT
TTACCTCAAAATCCCCAAAACTTAATTGATGATTTTTTAACGGCAATTATTGATAGTCAAGTCAAG
AAAGTTGCAGAAGAAAGTGAAAAAAAAGCGATTACAAATCTAACCGCTATTCAACCGATTGTTCAG
AGTTGGTTACACGCTTTAGCCAGTGAATCTAATCTAGCAAAATCCAAAAAATCTGAATCAAAAACC
CTAGAAAAAATTCTTTCCAATTGGACGGCTCCTCTTCAACAAACTCTCGCTGAACATAATTTGTTT
AGAACGGGATTTCGACTCTCTCCTCCGGAAAATAATCAAAAAAATTGGACGCTAGATTATTGTTTA
CAAGCAATTGATGAACCCGAATTTTTAGTGGATGCTCAAACTATTTGGACTCATCCAGTCGAAGCC
TTTGTTCACAATGGACGTATGATTAAACGTCCTCAAGAAACCCTCCTCAAAGGTTTAGGTTTAGCC
TCAAAACTATATCCTCTCCTAGAACCCAGTTTACAAGAAGCCCGTCCTCAAACTTGCTTATTAACG
CCCCTACAAGCCTATGAATTTATTAAAAGTATTAATTGGCGGTTTACAGATAGCGGTTTAGGAGTG

FIGURE 10 (continued)

ATTTTACCCCCGAGTTTAGTCAGTCAAAATGGATGGGCGAACCGTTTAGGTTTAAGTGTTCAAGCG
GCGACATCAAAATCCAAACAAAATGTTAGCTTGGGATTAGATAGTCTGCTGAATTTTAAATGGGAA
TTGTCAATTGGGGGTCAAACCTTATCAAAAACAGAATTTAACCGTTTAGTCGCTCAAGAAAGTCCG
TTAGTTGAAATTAATGGCGAATGGGTGGAATTACGTCCTACTGATATTAAAGCCGCTAAAGCCTTC
TTTTCGAGTCGCAAAGATCAACTTTCACTTACCCTTGAAGATGCTTTACGTTTATCGACGGGTGAC
TCGCAAATGGTGGAAAAGTTACCGATTGTTAACTTTGAAGCGGGTGGAAAATTAGAAGAACTTCTC
AATACTTTAACGAATAACCGTTCGCTCGATGAGATCAAAACTCCTAGTAATTTTCAAGGAGAACTA
CGCCCCTATCAAGCCCGAGGGGTGAGTTGGTTAGCCTTTTTAGAAGAATGGGGTTTAGGGGCTTGT
TTAGCTGATGATATGGGGCTAGGAAAAACCATAGAATTAATTGCTTTTCTCTTGTATTTGCAGGAA
AAAGAAACCTTAGACGCTCCTGTTTTACTGGTTTGTCCGACATCAGTTTTAGGAAACTGGGAACGA
GAAGTTAAACGATTTAGTCCGAGTTTAAAAGTTACTGTTCATCACGGGGATAAACGCCAGAAAGGG
AAAAACTTTGCTCAATTTGCCCAGAAATATAATTTAATTATTACCAGTTATCCGTTAACTTTTCGA
GATGAGAAAGAACTCAAAACGGTAAATTGGAAAGGATTAGTTTTAGACGAAGCTCAAAATATTAAA
AATCCCGAGGCTAAACAATCAAAAACGGTGAGAAATCTACAGGCGAGTTTTAAAATTGCTCTGACT
GGAACACCTGTCGAAAACCGTCTGTCTGAATTATGGTCAATTATGGATTTTCTCAACCCAGGTTAT
TTAGGACAGCGACAATTTTTTCAGCGAAGATTTGCTATTCCGATTGAAAAATACGGCGATACAGAC
TCCTTAAAAACATTGCGATCTTTGGTTCAACCGTTTATTTTACGGCGCTTAAAAACAGATAGAGAG
ATTATCCAAGACTTACCCGAAAAACAGGAAAATACGATCTTTTGTTCTCTGTCTACAGAACAAGCA
ACGCTTTATCAAAAGATTGTTGATCAGTCTTTAGCTGACATAGACTCAGCCGCAGGAATTCAACGT
CGAGGGATGATTTTAGCGTTGTTAGTGAAATTAAAACAGGTTTGTAATCATCCCATTTTATTGAAT
GGAAAAGCGACAAAAACTGGAAAGAAAAAGGTCGAGACTCAGGGTTTAAGCCTGCAAAGTTCAGGG
AAGTTACAACGCTTCAAAGAAATGCTGGAAGAATTGTTGTCAGAAGGAGATCGCGCCATTGTATTT
ACCCAGTTTGCAGAATGGGGAAAAGTTTTACAACCTTATTTAGAACAGCAATTAAACCGAGAGGTA
TTATTTTTGTATGGCGCAACTCGTAAAAATAAACGAGAAGAAATGATTGATCGTTTTCAACAAGAT
CCTCAAGGGCCACCGATTTTTATTCTATCTTTAAAAGCGGGAGGTGTGGGTTTAAATTTGACTCGT
GCTAATCATGTTTTTCACTTTGATCGTTGGTGGAACCCTGCGGTTGAAAATCAAGCAACAGATCGG
GTGTTTAGAATTGGTCAAACGCGCAATGTTCAGGTTCATAAGTTTGTCTGTACCGGAACGTTGGAA
GAAAAAATCCATGATTTAATTGAAAGTAAAAAAGTGTTGGCTGAACAAGTTGTGGGTTCAGGAGAA
AATTGGTTAACTGAATTGGATACGGATCAACTCAGAAACTTACTCATTATTGACCGAAATGCGGTG
ATTGATGAAGAAGAATAA

SEQ ID NO: 42, Lyngbya sp. PCC 8106 Lyn_sp_SNF2 translated polypeptide

MAILHGSWLQHPKNYLFIWGETWRRITPNEFNPADGVLGYPFALSPVELEKWCSEKQLSIESKVVV
TETLALPTKLSPKIGLYPLQSTPQTDSETDSESICLYPWKIEGICLNSTEAFDFLQSLPLGNLTTE
NSFIGSDLQFWSHLSRWSLDLLARSKFLPSLTFNPSKDHFIAEWKPLLDSATDQARLIRFSKQIPS
ACRIYQLWSKEAQNQFENLALDLPQNPQNLIDDFLTAIIDSQVKKVAEESEKKAITNLTAIQPIVQ
SWLHALASESNLAKSKKSESKTLEKILSNWTAPLQQTLAEHNLFRTGFRLSPPENNQKNWTLDYCL
QAIDEPEFLVDAQTIWTHPVEAFVHNGRMIKRPQETLLKGLGLASKLYPLLEPSLQEARPQTCLLT
PLQAYEFIKSINWRFTDSGLGVILPPSLVSQNGWANRLGLSVQAATSKSKQNVSLGLDSLLNFKWE
LSIGGQTLSKTEFNRLVAQESPLVEINGEWVELRPTDIKAAKAFFSSRKDQLSLTLEDALRLSTGD
SQMVEKLPIVNFEAGGKLEELLNTLTNNRSLDEIKTPSNFQGELRPYQARGVSWLAFLEEWGLGAC
LADDMGLGKTIELIAFLLYLQEKETLDAPVLLVCPTSVLGNWEREVKRFSPSLKVTVHHGDKRQKG
KNFAQFAQKYNLIITSYPLTFRDEKELKTVNWKGLVLDEAQNIKNPEAKQSKTVRNLQASFKIALT
GTPVENRLSELWSIMDFLNPGYLGQRQFFQRRFAIPIEKYGDTDSLKTLRSLVQPFILRRLKTDRE
IIQDLPEKQENTIFCSLSTEQATLYQKIVDQSLADIDSAAGIQRRGMILALLVKLKQVCNHPILLN
GKATKTGKKKVETQGLSLQSSGKLQRFKEMLEELLSEGDRAIVFTQFAEWGKVLQPYLEQQLNREV
LFLYGATRKNKREEMIDRFQQDPQGPPIFILSLKAGGVGLNLTRANHVFHFDRWWNPAVENQATDR
VFRIGQTRNVQVHKFVCTGTLEEKIHDLIESKKVLAEQVVGSGENWLTELDTDQLRNLLIIDRNAV
IDEEE

FIGURE 10 (continued)

SEQ ID NO: 43, Methanosarcina acetivorans C2A Metac_C2A_SNF2 nucleic acid sequence

ATGATAATTTTGCATGCAGGAAGAGTCGGAAAACAGTTCTTTCTGTGGGGCGAAAGCCCGGCTGAA
AATGAAACTCCGCCTGTCCGGCGCGGGAGAAAGCCTAAGAAGCCGGTTGCAAAACCTTATCCTTAC
GATTCGGGTGTTGAAAACCTGTCTTCTGCTCTTGAGCTGCTGCTGGGCAGTACTGGCCGGAAAAAG
GCAGAGGAAATCAATGTCTGGATCCCGACAGCAGGCTGGAATCCAATCCCCTCCAGTCCTCTCGTT
GCTGAAATTCCGGCTTCGAAAGCAGAACTTTCCCTAGCTCCCTGGACTGTTCACGCATATCCTCTG
GAAGCTGAAGAAGCTATTGTTCTCCTCTGCGCCTGTATGGGAAAAAAGGTTCTTGCTCCCGGCATA
ATCTCGGGAAATGATCTTCTCTGGTGGGCGGATGCCCTGAAATTTGCAGGCTCGCTGGTAGCAGGA
CAGAAATACCTGCCTGGCGTCAGGGGCGGGGAAGGAGAGTACAAGGCTTTCTGGGAACCCGTATTT
TCCGGAGAAGATGCGGGGGAGCTGGCAAGACTTGCAAAGCAAATGCCTCCGGCTGCAAAGGCTCTT
GCTCTTGAAACCTCTTCCGTGCAGCCGGAAATACTTGCTGCTGTAGCGGCAAGGCAGTTTATCGAA
GAGGCTCTTGACTGGATAGTCCGGTCCGAGATCGGGGAAAAAGAGCTTGCAAAAGAGGCGCGTAAA
AGAAAATCCTTTGATAGCGTCCATGACGCCTGGGTTTCCGCTCTTAAAAGCCCTGACGGGTTGATC
CACGGAGAAGAAAAAGAACTCCTGCAGCTTGCGTTCCGGACCCGTGAATGGCAGCGCCCCCTTACT
GTACTTACAACTTCTCCCTTCAGGTTCTGTTTCCGGCTTGAAGAGCCAGCTGCGGAAGAAGAACTC
GAAGAAACCGAGGAATCCGAAGCCGGAAAAATGGATACTAAAAAAGGCAGGAAAGGGATAGCTGAC
ATAGAAGTTCCCGAAGAACTCTGGTACGTCCGCTATATGCTTCAGTCCTACGAAGACCCAAGCCTT
CTGATTCCTGTAAAAGAGGCCTGGAAACCAAAGAAGGGCAGCCCGTTGAAAAGATATGATGTAAAA
AACATTCGCCAATTTCTGTTATCTTCCCTTGGACAGGCTGCTGGCATCAGTGCAGGAATTGCTTCC
AGCCTTGAAGCTCCCAACCCGTCCGGATATTCCCTTGATACGAAAGAAGCTTACCGCTTCCTGACT
GAAAGTGCAGCGGATTTAAGCCAGGCGGGCTTCGGGTTACTTCTCCCCGGCTGGTGGACCCGTAAA
GGTACAAAGACCCACTTAAAAGCCCAGGCTAATGTTAAGGGCAAGAAGTTGAAGGCCGGATACGGG
CTTACACTCGATAAAATCGTCAGCTTTGACTGGGAAATTGCCCTTGGAGACCGTGCACTCACAGTC
AGGGAACTGCAGGCTCTTGCAAAGCTCAAAGCTCCGCTTGTGAAATTCCGCGGGCAGTGGGTCGAG
GTCAACGATGCGGAAATCCGGGCTGCCCTTGAGTTCTGGAAGAAAAACCCCCACGGGGAAGCAAGT
CTGCGCGAAGTTCTAAAACTGGCTGTGGGAGTCTCCGAAAAAGCCGATGGTGTAGACGTTGAAGGG
CTTAATGCAGCCGGCTGGATCGAAGAATTAATCCGCCGCCTGAAGGACAAAACCGGGTTTGAAGAA
CTTCCGGCTCCTGACGGTTTTTCAGGCACCCTCAGGCCCTACCAGTTCAGAGGTTACTCCTGGCTG
GCTTTCCTGAGGCAGTGGGGCATAGGAGCCTGCCTTGCAGACGACATGGGGCTTGGTAAAACCATC
CAGACCCTTGCCCTTATCCAGCACGACCTGGAACAGGTTAAAGGGCAGGTTGAAGAAAAGGTTATA
GAAAATGCTGAAGAAAAAGTTGAAGGACTTAAAGCTGCAAAACCGGTTCTTCTGGTCTGTCCGACC
TCTGTCATCAACAACTGGAAAAAAGAGGCGGCTCGCTTTACCCCGGAACTTTCGGTAATGGTCCAC
CACGGGACCAGCCGGAAAAAGGAAGAGGAATTCAAAAAGGAAGCCACGAATCATTCTATTGTCGTC
TCAAGCTACGGGCTTTTGCAGCGGGATCTTAAGTTTTTAAAAGGGGTTTCCTGGGCCGGAGTGGTA
CTTGACGAAGCCCAGAATATCAAAAACCCGGAAACCAAACAGGCAAAGGCAGCCAGAGCTCTTGAA
GCCGATTACCGCATAGCTCTTACGGGGACTCCGGTTGAAAACAACGTGGGAGACCTCTGGTCTATC
ATGGAGTTTTTAAACCCCGGCTTCCTAGGCAACCAGGCAGGTTTCAAGCGGAATTTCTTTATTCCC
ATTCAGGCCGAAAGGGATCAGGAAGCTGCAAGGAGGTTAAAAGAAATTACGGGCCCCTTTATCCTG
CGCCGTCTGAAGACCGATACTTCGATTATCTCCGACCTGCCGGAAAAGATGGAAATGAAAACCTAT
TGTACGCTGACAAAAGAACAGGCTTCCCTCTATGCCGCAGTCCTCGAAGACATCGAAGAGACGATG
GAAGAGGCTGAAGAAGGCATCCAGAGAAAAGGTATAATCCTGTCCGCCCTTACCAGGCTCAAACAG
GTCTGCAACCATCCGGCGCAGTTTTTGAAGGATAACTCTGCTGTACCCGGCAGGTCAGGAAAACTT
GCAAGGCTTACCGAAATGCTGGATGTAATCCTGGAAAATGGGGAAAAAGCCCTTGTGTTCACCCAG
TTTGCGGAGATGGGAAAAATGCTAAAAGAACACCTGCAGGCAAGTTTTGGCTGTGAAGTCCTTTTC
CTGCACGGCGGGGTCCCCAGAAAGCAGAGGGATCGGATGCTTGAGCGTTTCCAGGAGGGAAAAGAA
TACCTCCCTATCTTTGTCCTCTCCCTTAAAGCTGGAGGCACGGGGCTTAACCTTACAGGAGCGAAC
CACGTTTTCCATTTTGACCGCTGGTGGAACCCTGCTGTTGAAAACCAGGCTACGGACAGGGCTTTC

FIGURE 10 (continued)

CGTATAGGCCAGACGAAAAATGTAGAGGTGCATAAGTTCATCTGTGCGGGTACGCTTGAAGAAAAA
ATCGATGAGATTATCGAGCGCAAAGTGCAGGTTGCAGAGAACGTTGTCGGAACAGGTGAAGGTTGG
CTGACAGAACTTTCCAACGAGGAATTGAAGGATATTCTTGCTCTCCGAGAAGAAGCGGTAGGTGAA
TAA

SEQ ID NO: 44, Methanosarcina acetivorans C2A Metac_C2A_SNF2 translated polypeptide

MIILHAGRVGKQFFLWGESPAENETPPVRRGRKPKKPVAKPYPYDSGVENLSSALELLLGSTGRKK
AEEINVWIPTAGWNPIPSSPLVAEIPASKAELSLAPWTVHAYPLEAEEAIVLLCACMGKKVLAPGI
ISGNDLLWWADALKFAGSLVAGQKYLPGVRGGEGEYKAFWEPVFSGEDAGELARLAKQMPPAAKAL
ALETSSVQPEILAAVAARQFIEEALDWIVRSEIGEKELAKEARKRKSFDSVHDAWVSALKSPDGLI
HGEEKELLQLAFRTREWQRPLTVLTTSPFRFCFRLEEPAAEEELEETEESEAGKMDTKKGRKGIAD
IEVPEELWYVRYMLQSYEDPSLLIPVKEAWKPKKGSPLKRYDVKNIRQFLLSSLGQAAGISAGIAS
SLEAPNPSGYSLDTKEAYRFLTESAADLSQAGFGLLLPGWWTRKGTKTHLKAQANVKGKKLKAGYG
LTLDKIVSFDWEIALGDRALTVRELQALAKLKAPLVKFRGQWVEVNDAEIRAALEFWKKNPHGEAS
LREVLKLAVGVSEKADGVDVEGLNAAGWIEELIRRLKDKTGFEELPAPDGFSGTLRPYQFRGYSWL
AFLRQWGIGACLADDMGLGKTIQTLALIQHDLEQVKGQVEEKVIENAEEKVEGLKAAKPVLLVCPT
SVINNWKKEAARFTPELSVMVHHGTSRKKEEEFKKEATNHSIVVSSYGLLQRDLKFLKGVSWAGVV
LDEAQNIKNPETKQAKAARALEADYRIALTGTPVENNVGDLWSIMEFLNPGFLGNQAGFKRNFFIP
IQAERDQEAARRLKEITGPFILRRLKTDTSIISDLPEKMEMKTYCTLTKEQASLYAAVLEDIEETM
EEAEEGIQRKGIILSALTRLKQVCNHPAQFLKDNSAVPGRSGKLARLTEMLDVILENGEKALVFTQ
FAEMGKMLKEHLQASFGCEVLFLHGGVPRKQRDRMLERFQEGKEYLPIFVLSLKAGGTGLNLTGAN
HVFHFDRWWNPAVENQATDRAFRIGQTKNVEVHKFICAGTLEEKIDEIIERKVQVAENVVGTGEGW
LTELSNEELKDILALREEAVGE

SEQ ID NO: 45, Methanospirillum hungatei JF-1 Methu_JF-1_SNF2 nucleic acid sequence

GTGACCGCGAAACGACCAGCACCAATCCACGATAAAGAAGAAGAGACCATACCCGATACTTCGCTT
CCGGTCTTTCATGCCCTGATTTACCCGGCCGTTGAAGGGGTAGCGATATGTGCCGAATATATAACT
GATAAACCTGCACCGGTCAGGAAAAAAGGCTACGCAAAGGATAAACCTGGCGAATATCCATATTCC
CTGGATCATACCGCCCTTAAAACGCTCATAGAGAACTGTTTTGGAGCATATGATGACCTGAAGGCT
ACCAGATGGATTATCTATCTCCCCGCTGAAGAAACGGTTCCTCCTTCCTCTCAGTTCTCATCAAAA
AAGAAGCCATCACCAAAGGAGAAAAAACTCCCCCTTGTTCCGATGTATATCCCCGTTCTTCTCTGC
CCGTATGAAACCTTTTTTCAAATCTGGAAAGCCGCTCAGAATACAGATAAAAATTATATTGCTGGC
GATTCCTTCCAGTACATCTCCATTCTGATGGAGAGTACCGTCCGGCTCATACAAAACGGACGGTTC
AAACCATCTCTAGAACGGACCTTTGCCGGATATCATGCCGTATGGGTACCTGCCCTTTCTCCTCAG
GATATGGAATGGGTATCAGATTTTTCAAGCCGGATGCCAACGGTCTGCAAGTACGCTATCCCCCGG
GTCGCAAAAGATCCCTACATTTATAAACCTGAGACCAGATTAGAGAAATTCATCGTTGAGATGATG
CGGGTGATCATCCGTACTGCCCTTGGTGGTTATACACTGAAAGAAGAGACAGATCCCTTTTATGAA
CCCTCAGAAAACGAGATGCAGTTCATGACTGACCTTCTCGGGGTAACCGACCCAATAAGGAACAAA
GGATTTGAGAGAACTTTCTTACGGGCGATGCAGGACTGGCTGACCTTCTCAAGTTCAGGACGGTTT
GCTCCCTTTGAGTTCTGCATGATCATAAAAGATCCACCAGAAGGACAGACAGAACCATGGGATTTC
ACTCTCGCGGTCAGATCAGAGGCAGAACCATCTCTTCTCATCCCGGCAGAAATAATCTGGGAATTG
CCTGATCACCAGAGCGGGCTCTTCCCCCAGGCAGCCTATCTCAAACATATCCTCCTTGCTGGTATC
GGGCTCTTGACCTCATCATCATCGGCATTATGGCGTCCCCTGTCCGGATCGAAACCCACCGGGGGA
AGTATGACCCTGAAAGAGGCTGCAACGTTCTTGGGTTCAGACCTCGCAAGAGCCAGGAGGAAGGGA
GTAACGGTGCTCCTGCCAGACTGGTGGACTGATACGACCTATACACCACGGGTTGAAATCCATGCA
AGGCGGCGGGATCCCACCCATACGCAGACACGGATAGGACTGCAGGAACTCCTTTCTTTTGATTAC

FIGURE 10 (continued)

CGGATTGCAATCGGTGATGAGTCATTTTCACCGGATGAGTTCTGGGAAAAGGTAAAAGAAAAGGCT
CCCTTTATCTGGCTGGGGAACCGGTGGATATCCTTTCATCCGGATGCGATACAACATGCCCTGGAT
TCTTTCAGCAGGCATCAGAGCAAAGGAGGGGATACAATAGGAGATCTGCTCCGGCTCTCCCTGAAA
AAAATGGAGGATTCCGCGGTACCGGTATCGATTCATGCAAAAGATGACTGGGTTGCGGATCTTCTG
GATTTTTTCAGGACCGAAACAAATCAGGCAGTTCCAGTCCCAAAGAAATTTAAAGGGATACTCAGG
CCATACCAGGAAGAGGGGTTCTCCTTCCTTTGTCAATGTACCAGAAGGGGCTTTGGAGCCTGCCTT
GCAGATGACATGGGGCTTGGAAAAACTCCCCAGACACTTGCATGGCTGGTCTATCTCAAGGAGAAA
GAAAAACCCACGACTCCGTCCCTCCTTATATGCCCGATGTCGGTTGTTGGGAACTGGGAGCGGGAG
ATACAGCGGTTTGCGCCATCACTCCGTTCATGGGTGCATCATGGGACTGACCGATGCAAAGGCGAT
GATTTTGTGAGACATGTCGGTTCATATGACCTGGTCCTGACCACCTATCATCTGGCAGCACGGGAC
GTAGACCACCTCAAAACCGTTCCCTGGTCTGCAATCATTCTTGACGAGGCACAAAATATCAAGAAC
CTCCATGCAAACCAGACCGTAGCAGTCAAATCTCTCACCGGTGAGAGACGGGTTGCTCTGACCGGA
ACCCCGGTGGAGAACCGGTTACTCGAACTCTGGTCTATCATGGACTTTTTAAATCCAGGATACCTT
GGTTCACAGAGTGCATTTACAAACCGCTATTCCCGCCCGATTGAGCAGGAAAAAAATACGGAACTG
ATACAGGAATTAAGGTCCCTCATCCGTCCGTTCCTGCTCAGGCGGATGAAAACAGACAAGCATGTT
ATCGATGATCTTCCGGAAAAGATGGAGAACCGGGTATATTGCACCCTCACACCCGAACAGGCAACC
TTATATCAGGCTGTTGTGCTTGATATGGCAAAGAACCTTGATAAAGTGGAGGGTATTGCCAGGAAA
GGGGCAATCCTTGCTGCGATCACACGACTGAAACAGATCTGTAACCATCCGGGACGTGTTGGCAGG
GATAAAACAATAAAGGCTGAGCGGTCCGGGAAGGTGAGCCGGCTGCTTGAGATGATTGAGGAGATC
ACTTCCGAAGGGGACTCAGCACTCATATTCAGTCAGTATGCAACATTTGCTGAGGAACTGGCAGGG
ATGATAGAGAAACAGGGAGATACGCCCGTTCTTCTCCTGACCGGGTCAACACCACGGAAAAAACGG
GAACAGATGATAGAGGAGTTTCAGGCCTCAACCACCCCGATAATCTTTGTTATTTCTCTGAAAGCC
GGGGGAACGGGTCTGAACCTGACGAAAGCGACTCATGTGTTTCATGTAGACCGGTGGTGGAATCCG
GCGGTTGAAGACCAGGCTACTGACCGGACGTACCGGATCGGACAAAAGAGAAATGTCCAAGTTCAC
CTGATGATAACCGCCGGAACCCTGGAGGAACGGATAGATCTGATAAACCAGGAGAAACGGACGCTT
GCAAAGGAAGTCCTTGCACAGAGTGATGAGTATCTGACAAATCTCTCAACAAAAGAACTTCTGGAG
ATTGTATCACTTCGTGACAGTCTCTTTCGCGGGGAGGATGCATGA

SEQ ID NO: 46, Methanospirillum hungatei JF-1 Methu_JF-1_SNF2 translated polypeptide

VTAKRPAPIHDKEEETIPDTSLPVFHALIYPAVEGVAICAEYITDKPAPVRKKGYAKDKPGEYPYS
LDHTALKTLIENCFGAYDDLKATRWIIYLPAEETVPPSSQFSSKKKPSPKEKKLPLVPMYIPVLLC
PYETFFQIWKAAQNTDKNYIAGDSFQYISILMESTVRLIQNGRFKPSLERTFAGYHAVWVPALSPQ
DMEWVSDFSSRMPTVCKYAIPRVAKDPYIYKPETRLEKFIVEMMRVIIRTALGGYTLKEETDPFYE
PSENEMQFMTDLLGVTDPIRNKGFERTFLRAMQDWLTFSSSGRFAPFEFCMIIKDPPEGQTEPWDF
TLAVRSEAEPSLLIPAEIIWELPDHQSGLFPQAAYLKHILLAGIGLLTSSSSALWRPLSGSKPTGG
SMTLKEAATFLGSDLARARRKGVTVLLPDWWTDTTYTPRVEIHARRRDPTHTQTRIGLQELLSFDY
RIAIGDESFSPDEFWEKVKEKAPFIWLGNRWISFHPDAIQHALDSFSRHQSKGGDTIGDLLRLSLK
KMEDSAVPVSIHAKDDWVADLLDFFRTETNQAVPVPKKFKGILRPYQEEGFSFLCQCTRRGFGACL
ADDMGLGKTPQTLAWLVYLKEKEKPTTPSLLICPMSVVGNWEREIQRFAPSLRSWVHHGTDRCKGD
DFVRHVGSYDLVLTTYHLAARDVDHLKTVPWSAIILDEAQNIKNLHANQTVAVKSLTGERRVALTG
TPVENRLLELWSIMDFLNPGYLGSQSAFTNRYSRPIEQEKNTELIQELRSLIRPFLLRRMKTDKHV
IDDLPEKMENRVYCTLTPEQATLYQAVVLDMAKNLDKVEGIARKGAILAAITRLKQICNHPGRVGR
DKTIKAERSGKVSRLLEMIEEITSEGDSALIFSQYATFAEELAGMIEKQGDTPVLLLTGSTPRKKR
EQMIEEFQASTTPIIFVISLKAGGTGLNLTKATHVFHVDRWWNPAVEDQATDRTYRIGQKRNVQVH
LMITAGTLEERIDLINQEKRTLAKEVLAQSDEYLTNLSTKELLEIVSLRDSLFRGEDA

FIGURE 10 (continued)

SEQ ID NO: 47, Methanosarcina mazei Goe1 Metma_Go1_SNF2 nucleic acid sequence

ATGATAATTCTTCATGCAGGAAGAGTTGGAAAACAGTTCTTCTTATGGGGTGAAAGCCCGGCAGAA
AATGAAACTCCGGTTGTTCGGCGCGGGAGAAAGCCTAAAACCCCTATCGTAAAACCTTACCCTTAC
GATTCGGGCTTTGAAAACCTGTCTTCTGCCCTTGAGCTGCTGCTGGGCAGTACTGACCGGAAAAAG
GCGGAGAAAATCAACGTCTGGACCCCAACTATCGGAGGGAATCCTGTCCCTTCCAGCCCTCTTGTT
GCTGAAATTTCGGATTCGAAAGCAGAACCTGCACTGGCTCCCTGTACTGTTCACGCATATCCTCTG
GAAGCTGAAGAAGCTATTGTTCTCCTCTGCACCTGTATGGAAAAAAAGGTTCTGGCTCCCGGTATC
ATCTCGGGAAATGACCTTCTCTGGTGGGCAGATGCCCTGAAATTTGCAGGCTCGCTGGTAGCAGGG
CAGAAATATTTGCCTGGCGTCAGGGGCGGGGAAGGAGAGTACAGGGCTTTCTGGGAACCCGTATTT
TCCGGCGAAGATGCCGGAAAGCTGGCAAAACTTGCAAAGCAAATGCCTCCTGCTGCAAGGGCTCTT
GCTCCTGAAGCCTCTTCCATGCCGCCGGAAATGCCTGCTGCTTTAGCGGCAAAGCAGTTTATTGAA
GACTCTCTCGACTGGATAGTCCGGTCCGAGATCGGGGAAAAAAAGCTTGCAAAAGAGACGCGCAAA
AGAAAATCCTTTGATAGCGTCCATGATGCCTGGGTTTCTGCTCTTAGAAGCCCTGAAGGGCTGATC
TATGGAGACGAAAACGAACTTCTGCAGCTTGCGGCCCGGACCCGCGAATGGCAGCGCCCACTCACC
ATCCTTACCACTTCTCCTTTCAGGTTCTGTTTCCGTCTTGAAGAACCGGCTTTAGAAGAAGAGATC
GAAGAAACTGAAGAAACCGAAGAAATAGAAGAAAATGAAGCCGGGAAAAGAGATACTAAAAAAGGC
AGGGAAGGGATAGCTGATATAGAAGTTCCCGAAGGGCTCTGGTACGTCCGTTATATGCTTCAGTCC
TACGAAGACCCGAGCCTTCTGATCCCTGTAAAAGAAGCCTGGAAGCCAAAAAAAGGCAGCCCGTTG
AAAAAATACGATGTGAAAAACATTCGCCAATTCCTGTTATCTTCCCTTGGACAGGCTTCCAGTATA
AGTGCAGGAATTGCTTCGAGTCTTGAAGCTCCCAACCCATCTGGATATTCCCTTGATACTAAAGAG
GCTTACCGCTTTCTGACTGAAAGTGCAGCGAATTTAAGTCAGGCCGGTTTCGGGGTACTTCTCCCT
GGCTGGTGGACCCGTAAAGGTACAAAGACACACTTAAAAGCCCAGGCTAATGTTAAGGGCAAGAAG
AAGTTGCAGGCCGGATACGGGCTTACACTCGATGAAATCGTCAGCTTTGACTGGGAAATCGCCCTT
GGAGACAGGGTACTGACAGTCAGAGAACTGCAGGCTCTTGCAAAGCTTAAAGCTCCGCTTGTGAAA
TTCCGCGGGCAGTGGGTTGAGGTAAACGATGCGGAAATCAGGGCTGCCCTTGAGTTCTGGAAGAAA
AATCCCAACGGTGAAGCAAGTCTGCGTGAAGTTCTAAAACTGGCAGTGGGAGTTTCCGAAAAAGCC
GATGGTGTGAACGTTGAAGGGCTCAATGCAACCGGATGGATTGGAGAATTAATCAGCCGCTTAAAA
GACAAAACCGGGTTTGAAGAACTTCCTGCTCCCAACGGCTTTTCAGGCACCCTTCGGCCATATCAG
TTCAGAGGTTACTCCTGGCTGGCTTTTCTGAGGCAGTGGGGTATAGGAGCCTGCCTTGCAGACGAT
ATGGGGCTTGGTAAAACCGTCCAGACTCTTGCTCTTATTCAGCACGATCTGGAACAGGCTAAAGAG
AAAGCTGAAGAAAAGATTGAAGAACCGGCTGAAGAAAAGATTGAAGAAAAAGTTGACGGACGTAAG
GCCCCAAAACCTGTTCTTCTGGTTTGTCCTACCTCTGTTATCAACAACTGGAAAAAAGAGGCTTCC
CGCTTTACGCCAGAACTTTCGGTAATGGTCCACCACGGGACCAGCCGGAAAAAGGAAGAGGAATTC
AAGAAGGAAGCCATGAATCATGCTATTGTCATCTCAAGCTATGGCCTTGTGCAGCGGGATCTTAAA
TTTTTAAAAGAGGTTCATTGGGCAGGAGTTGTACTTGACGAAGCCCAGAACATCAAAAACCCGGAA
ACCAAACAGGCAAAGGCAGCCAGGGCTCTTGAATCCGATTACCGCTTAGCTCTTACAGGGACTCCG
GTTGAAAATAACGTGGGAGACCTCTGGTCCATAATGGAGTTTTTAAACCCCGGCTTCCTCGGAAGT
CAGGCGGGTTTCAAGCGGAATTTCTTTATCCCCATTCAGGCAGAAAGGGATCAGGAGGCTGCAAGG
AGGCTGAAAGAAATTACAGGTCCCTTCATCCTTCGCCGTTTGAAGACTGACACTTCGATTATCTCC
GACCTGCCGGAAAAAATGGAGATGAAGACCTATTGTACGCTGACAAAAGAACAGGCCTCCCTCTAT
GCTGCAGTCCTTGAAGACATCAGAGAAGCGATTGAAGGAGCCGAAGAAGGCATCCAGAGGAAAGGT
ATAATCCTGTCTGCCCTTTCCAGGCTCAAGCAGGTCTGCAACCACCCTGCGCAGTTTTTGAAGGAC
AACTCCACTATCCCCGGCAGGTCCGGAAAACTCGCAAGGCTTACCGAAATGCTGGATGTAGTCCTG
GAAAACGGGGAAAAAGCCCTTGTTTTTACCCAGTTTGCGGAGATGGGCAAAATGGTGAAAGAACAC
CTGCAAGCAAGCTTTGGCTGTGAAGTCCTTTTCCTGCACGGCGGGGTCCCCAGGAAGCAGAGAGAC
CGGATGCTTGAGAGGTTCCAGGAAGGAAAAGAATACCTCCCTATTTTTGTCCTCTCCCTTAAAGCC
GGCGGCACGGGGCTTAACCTCACAGGGGCAAACCACGTTTTCCACTTTGATCGCTGGTGGAACCCG

FIGURE 10 (continued)

GCTGTTGAAAACCAGGCTACAGACAGGGCATTCCGTATAGGCCAGAAGAAAAACGTTGAGGTCCAT
AAATTCATCTGCGCAGGTACGCTTGAAGAAAAAATCGATGAGATTATCGAACGCAAAGTGCAGGTC
GCAGAGAACGTTGTTGGGACAGGTGAAGACTGGCTGACAGAGCTTTCCAACGATGAACTGAAGGAT
ATTCTTGCTCTTAGAGAAGAAGCGGTAGGTGAATAA

SEQ ID NO: 48, Methanosarcina mazei Goe1 Metma_Goe1_SNF2 translated polypeptide

MIILHAGRVGKQFFLWGESPAENETPVVRRGRKPKTPIVKPYPYDSGFENLSSALELLLGSTDRKK
AEKINVWTPTIGGNPVPSSPLVAEISDSKAEPALAPCTVHAYPLEAEEAIVLLCTCMEKKVLAPGI
ISGNDLLWWADALKFAGSLVAGQKYLPGVRGGEGEYRAFWEPVFSGEDAGKLAKLAKQMPPAARAL
APEASSMPPEMPAALAAKQFIEDSLDWIVRSEIGEKKLAKETRKRKSFDSVHDAWVSALRSPEGLI
YGDENELLQLAARTREWQRPLTILTTSPFRFCFRLEEPALEEEIEETEETEEIEENEAGKRDTKKG
REGIADIEVPEGLWYVRYMLQSYEDPSLLIPVKEAWKPKKGSPLKKYDVKNIRQFLLSSLGQASSI
SAGIASSLEAPNPSGYSLDTKEAYRFLTESAANLSQAGFGVLLPGWWTRKGTKTHLKAQANVKGKK
KLQAGYGLTLDEIVSFDWEIALGDRVLTVRELQALAKLKAPLVKFRGQWVEVNDAEIRAALEFWKK
NPNGEASLREVLKLAVGVSEKADGVNVEGLNATGWIGELISRLKDKTGFEELPAPNGFSGTLRPYQ
FRGYSWLAFLRQWGIGACLADDMGLGKTVQTLALIQHDLEQAKEKAEEKIEEPAEEKIEEKVDGRK
APKPVLLVCPTSVINNWKKEASRFTPELSVMVHHGTSRKKEEEFKKEAMNHAIVISSYGLVQRDLK
FLKEVHWAGVVLDEAQNIKNPETKQAKAARALESDYRLALTGTPVENNVGDLWSIMEFLNPGFLGS
QAGFKRNFFIPIQAERDQEAARRLKEITGPFILRRLKTDTSIISDLPEKMEMKTYCTLTKEQASLY
AAVLEDIREAIEGAEEGIQRKGIILSALSRLKQVCNHPAQFLKDNSTIPGRSGKLARLTEMLDVVL
ENGEKALVFTQFAEMGKMVKEHLQASFGCEVLFLHGGVPRKQRDRMLERFQEGKEYLPIFVLSLKA
GGTGLNLTGANHVFHFDRWWNPAVENQATDRAFRIGQKKNVEVHKFICAGTLEEKIDEIIERKVQV
AENVVGTGEDWLTELSNDELKDILALREEAVGE

SEQ ID NO: 49, Mycobacterium bovis BCG Pasteur 1173P2 Mycbo_SNF2 nucleic acid sequence

ATGCTGGTTTTGCACGGCTTCTGGTCCAACTCCGGCGGGATGCGGCTGTGGGCGGAGGACTCCGAT
CTGCTGGTGAAGAGCCCGAGTCAGGCGCTGCGCTCCGCGCGGCCACACCCGTTCGCGGCGCCCGCT
GACCTGATCGCCGGCATACATCCGGGCAAACCCGCAACCGCCGTTTTGCTGTTGCCGTCGTTGCGA
TCGGCGCCGCTGGACTCGCCGGAGCTGATCCGGCTCGCCCCGCGCCCGGCCGCGCGAACCGATCCG
ATGCTGTTGGCGTGGACGGTACCGGTGGTGGACCTGGACCCCACCGCGGCGTTGGCCGCCTTCGAC
CAGCCCGCCCCCGACGTCCGCTACGGCGCGTCCGTCGACTACCTGGCCGAGCTGGCCGTTTTCGCG
CGCGAGTTGGTCGAGCGTGGTCGCGTGCTGCCCCAGCTGCGCCGCGACACCCACGGCGCGGCCGCC
TGCTGGCGTCCGGTGTTGCAGGGACGCGACGTGGTCGCGATGACCTCGCTGGTCTCGGCGATGCCG
CCGGTCTGCCGCGCCGAAGTTGGTGGGCACGACCCGCACGAACTGGCAACCTCGGCTCTGGACGCG
ATGGTCGACGCCGCCGTGCGCGCGGCGCTGTCACCGATGGACCTGCTGCCCCCGCGACGGGGTCGC
TCCAAACGGCATCGGGCCGTGGAGGCTTGGCTGACCGCGTTGACCTGCCCGGACGGCCGGTTCGAC
GCGGAGCCCGACGAACTCGACGCGCTGGCCGAGGCGTTGCGGCCATGGGACGACGTCGGTATCGGC
ACCGTCGGCCCGGCGCGGGCGACGTTTCGGCTGTCCGAAGTCGAGACCGAAAACGAGGAGACGCCC
GCGGGCTCGTTGTGGAGGCTGGAGTTCTTATTGCAGTCGACGCAGGACCCCAGCCTGCTGGTCCCC
GCCGAGCAGGCATGGAACGACGACGGCAGCCTGCGCCGCTGGCTGGACCGGCCGCAGGAGCTGCTG
CTGACCGAACTGGGCCGGGCCTCTCGGATTTTCCCCGAGCTCGTCCCGGCGCTGCGCACCGCGTGC
CCGTCCGGGCTTGAGCTCGACGCCGACGGCGCCTACCGATTCCTGTCGGGTACGGCCGCGGTGCTC
GACGAGGCTGGGTTTGGCGTGCTGCTGCCGTCCTGGTGGGACCGCCGCCGCAAGCTGGGCTTGGTC
CTGTCCGCATATACCCCGGTCGACGGCGTGGTGGGCAAGGCCAGCAAGTTCGGCCGCGAGCAGCTC
GTCGAGTTCCGCTGGGAGCTGGCCGTGGGCGACGATCCGCTCAGCGAGGAGGAGATCGCGGCGCTG
ACCGAAACCAAGTCCCCGCTGATCCGGCTGCGTGGCCAGTGGGTGGCGCTCGATACCGAACAGCTG

FIGURE 10 (continued)

CGCCGCGGGCTGGAGTTTTTGGAGCGTAAGCCAACCGGCCGCAAGACCACCGCCGAGATCCTCGCG
CTGGCCGCCAGCCACCCCGACGACGTGGACACCCCGCTCGAGGTCACCGCCGTACGCGCCGACGGC
TGGCTCGGGGACCTGCTCGCCGGGGCCGCCGCGGCGTCGCTGCAGCCGTTGGACCCGCCCGACGGA
TTCACCGCGACGCTGCGTCCCTACCAGCAGCGCGGTCTGGCGTGGCTGGCGTTTTTGTCCTCGCTC
GGTTTGGGCAGCTGCCTGGCCGACGACATGGGCCTGGGCAAGACGGTGCAGCTATTGGCCCTGGAA
ACCTTGGAATCCGTTCAGCGCCACCAGGATCGCGGCGTCGGACCCACACTGCTACTGTGCCCGATG
TCGTTGGTGGGCAACTGGCAGCAGGAAGCGGCCAGGTTTGCACCCAACCTGCGGGTGTACGCCCAC
CACGGGGGCGCCCGGCTGCACGGCGAGGCGTTGCGCGACCACCTCGAGCGCACCGACCTGGTCGTG
AGCACCTATACCACCGCCACCCGCGACATCGACGAGCTGTCGGAATACGAATGGAACCGGGTGGTG
CTGGACGAGGCCCAGGCGGTGAAGAACAGCCTGTCCCGGGCGGCCAAGGCGGTGCGACGGCTACGC
GCGGCGCACCGGGTCGCGCTGACCGGGACACCGATGGAGAACCGGCTCGCCGAGCTGTGGTCGATC
ATGGACTTCCTCAACCCGGGCCTGCTCGGATCCTCCGAACGCTTCCGCACCCGCTACGCGATCCCG
ATCGAGCGGCACGGGCACACCGAACCGGCCGAACGGCTGCGCGCATCGACGCGGCCCTACATCCTG
CGCCGGCTCAAGACCGACCCGGCGATCATCGACGATCTGCCGGAGAAGATCGAGATCAAGCAGTAC
TGCCAACTCACCACCGAGCAGGCGTCGCTGTATCAGGCCGTCGTCGCCGACATGATGGAAAAGATC
GAAAACACCGAAGGGATCGAGCGGCGCGGCAACGTGCTGGCCGCGATGGCCAAGCTCAAACAGGTG
TGCAACCACCCCGCCCAGCTGCTGCACGATCGCTCCCCGGTCGGTCGGCGGTCCGGGAAGGTGATC
CGGCTCGAGGAGATCCTGGAAGAGATCCTGGCCGAGGGCGACCGGGTGCTGTGTTTTACCCAGTTC
ACCGAGTTCGCCGAGCTGCTGGTGCCGCACCTGGCCGCACGCTTCGGCCGTGCCGCCCGAGACATT
GCCTACCTGCACGGTGGCACCCCGAGGAAGCGGCGTGACGAGATGGTGGCCCGGTTCCAGTCCGGT
GACGGCCCGCCCATTTTTCTGCTGTCGTTGAAGGCGGGCGGTACCGGGCTGAACCTCACCGCCGCC
AATCATGTTGTGCACCTGGACCGCTGGTGGAACCCGGCGGTCGAGAACCAGGCGACGGACCGGGCG
TTTCGGATCGGGCAGCGGCGCACGGTGCAGGTCCGCAAGTTCATCTGCACCGGCACCCTCGAGGAG
AAGATCGACGAAATGATCGAGGAGAAAAAGGCGCTGGCCGACTTGGTGGTCACCGACGGCGAAGGC
TGGCTGACCGAACTGTCCACCCGCGATCTGCGCGAGGTGTTCGCGCTGTCCGAAGGCGCCGTCGGT
GAGTAG

SEQ ID NO: 50, Mycobacterium bovis BCG Pasteur 1173P2 Mycbo_SNF2 translated polypeptide

MLVLHGFWSNSGGMRLWAEDSDLLVKSPSQALRSARPHPFAAPADLIAGIHPGKPATAVLLLPSLR
SAPLDSPELIRLAPRPAARTDPMLLAWTVPVVDLDPTAALAAFDQPAPDVRYGASVDYLAELAVFA
RELVERGRVLPQLRRDTHGAAACWRPVLQGRDVVAMTSLVSAMPPVCRAEVGGHDPHELATSALDA
MVDAAVRAALSPMDLLPPRRGRSKRHRAVEAWLTALTCPDGRFDAEPDELDALAEALRPWDDVGIG
TVGPARATFRLSEVETENEETPAGSLWRLEFLLQSTQDPSLLVPAEQAWNDDGSLRRWLDRPQELL
LTELGRASRIFPELVPALRTACPSGLELDADGAYRFLSGTAAVLDEAGFGVLLPSWWDRRRKLGLV
LSAYTPVDGVVGKASKFGREQLVEFRWELAVGDDPLSEEEIAALTETKSPLIRLRGQWVALDTEQL
RRGLEFLERKPTGRKTTAEILALAASHPDDVDTPLEVTAVRADGWLGDLLAGAAAASLQPLDPPDG
FTATLRPYQQRGLAWLAFLSSLGLGSCLADDMGLGKTVQLLALETLESVQRHQDRGVGPTLLLCPM
SLVGNWQQEAARFAPNLRVYAHHGGARLHGEALRDHLERTDLVVSTYTTATRDIDELSEYEWNRVV
LDEAQAVKNSLSRAAKAVRRLRAAHRVALTGTPMENRLAELWSIMDFLNPGLLGSSERFRTRYAIP
IERHGHTEPAERLRASTRPYILRRLKTDPAIIDDLPEKIEIKQYCQLTTEQASLYQAVVADMMEKI
ENTEGIERRGNVLAAMAKLKQVCNHPAQLLHDRSPVGRRSGKVIRLEEILEEILAEGDRVLCFTQF
TEFAELLVPHLAARFGRAARDIAYLHGGTPRKRRDEMVARFQSGDGPPIFLLSLKAGGTGLNLTAA
NHVVHLDRWWNPAVENQATDRAFRIGQRRTVQVRKFICTGTLEEKIDEMIEEKKALADLVVTDGEG
WLTELSTRDLREVFALSEGAVGE

FIGURE 10 (continued)

SEQ ID NO: 51, Mycobacterium tuberculosis H37Rv Myctu_SNF2 nucleic acid sequence

ATGCTGGTTTTGCACGGCTTCTGGTCCAACTCCGGCGGGATGCGGCTGTGGGCGGAGGACTCCGAT
CTGCTGGTGAAGAGCCCGAGTCAGGCGCTGCGCTCCGCGCGGCCACACCCGTTCGCGGCGCCCGCT
GACCTGATCGCCGGCATACATCCGGGCAAACCCGCAACCGCCGTTTTGCTGTTGCCGTCGTTGCGA
TCGGCGCCGCTGGACTCGCCGGAGCTGATCCGGCTCGCCCCGCGCCCGGCCGCGCGAACCGATCCG
ATGCTGTTGGCGTGGACGGTACCGGTGGTGGACCTGGACCCCACCGCGGCGTTGGCCGCCTTCGAC
CAGCCCGCCCCCGACGTCCGCTACGGCGCGTCCGTCGACTACCTGGCCGAGCTGGCCGTTTTCGCG
CGCGAGTTGGTCGAGCGTGGTCGCGTGCTGCCCCAGCTGCGCCGCGACACCCACGGCGCGGCCGCC
TGCTGGCGTCCGGTGTTGCAGGGACGCGACGTGGTCGCGATGACCTCGCTGGTCTCGGCGATGCCG
CCGGTCTGCCGCGCCGAAGTTGGTGGGCACGACCCGCACGAACTGGCAACCTCGGCTCTGGACGCG
ATGGTCGACGCCGCCGTGCGCGCGGCGCTGTCACCGATGGACCTGCTGCCCCCGCGACGGGGTCGC
TCCAAACGGCATCGGGCCGTGGAGGCTTGGCTGACCGCGTTGACCTGCCCGGACGGCCGGTTCGAC
GCGGAGCCCGACGAACTCGACGCGCTGGCCGAGGCGTTGCGGCCATGGGACGACGTCGGTATCGGC
ACCGTCGGCCCGGCGCGGGCGACGTTTCGGCTGTCCGAAGTCGAGACCGAAAACGAGGAGACGCCC
GCGGGCTCGTTGTGGAGGCTGGAGTTCTTATTGCAGTCGACGCAGGACCCCAGCCTGCTGGTCCCC
GCCGAGCAGGCATGGAACGACGACGGCAGCCTGCGCCGCTGGCTGGACCGGCCGCAGGAGCTGCTG
CTGACCGAACTGGGCCGGGCCTCTCGGATTTTCCCCGAGCTCGTCCCGGCGCTGCGCACCGCGTGC
CCGTCCGGGCTTGAGCTCGACGCCGACGGCGCCTACCGATTCCTGTCGGGTACGGCCGCGGTGCTC
GACGAGGCTGGGTTTGGCGTGCTGCTGCCGTCCTGGTGGGACCGCCGCCGCAAGCTGGGCTTGGTC
CTGTCCGCATATACCCCGGTCGACGGCGTGGTGGGCAAGGCCAGCAAGTTCGGCCGCGAGCAGCTC
GTCGAGTTCCGCTGGGAGCTGGCCGTGGGCGACGATCCGCTCAGCGAGGAGGAGATCGCGGCGCTG
ACCGAAACCAAGTCCCCGCTGATCCGGCTGCGTGGCCAGTGGGTCGCGCTCGATACCGAACAGATG
CGCCGCGGGCTGGAGTTTTTGGAGCGTAAGCCAACCGGCCGCAAGACCACCGCCGAGATCCTCGCG
CTGGCCGCCAGCCACCCCGACGACGTGGACACCCCGCTCGAGGTCACCGCCGTACGCGCCGACGGC
TGGCTCGGGGACCTGCTCGCCGGGGCCGCCGCGGCGTCGCTGCAGCCGTTGGACCCGCCCGACGGA
TTCACCGCGACGCTGCGTCCCTACCAGCAGCGCGGTCTGGCGTGGCTGGCGTTTTTGTCCTCGCTC
GGTTTGGGCAGCTGCCTGGCCGACGACATGGGCCTGGGCAAGACGGTGCAGCTATTGGCCCTGGAA
ACCTTGGAATCCGTTCAGCGCCACCAGGATCGCGGCGTCGGACCCACACTGCTACTGTGCCCGATG
TCGTTGGTGGGCAACTGGCCGCAGGAAGCGGCCAGGTTTGCACCCAACCTGCGGGTGTACGCCCAC
CACGGGGGCGCCCGGCTGCACGGCGAGGCGTTGCGCGACCACCTCGAGCGCACCGACCTGGTCGTG
AGCACCTATACCACCGCCACCCGCGACATCGACGAGCTGGCGGAATACGAATGGAACCGGGTGGTG
CTGGACGAGGCCCAGGCGGTGAAGAACAGCCTGTCCCGGGCGGCCAAGGCGGTGCGACGGCTACGC
GCGGCGCACCGGGTCGCGCTGACCGGGACACCGATGGAGAACCGGCTCGCCGAGCTGTGGTCGATC
ATGGACTTCCTCAACCCGGGCCTGCTCGGATCCTCCGAACGCTTCCGCACCCGCTACGCGATCCCG
ATCGAGCGGCACGGGCACACCGAACCGGCCGAACGGCTGCGCGCATCGACGCGGCCCTACATCCTG
CGCCGGCTCAAGACCGACCCGGCGATCATCGACGATCTGCCGGAGAAGATCGAGATCAAGCAGTAC
TGCCAACTCACCACCGAGCAGGCGTCGCTGTATCAGGCCGTCGTCGCCGACATGATGGAAAAGATC
GAAAACACCGAAGGGATCGAGCGGCGCGGCAACGTGCTGGCCGCGATGGCCAAGCTCAAACAGGTG
TGCAACCACCCCGCCCAGCTGCTGCACGATCGCTCCCCGGTCGGTCGGCGGTCCGGGAAGGTGATC
CGGCTCGAGGAGATCCTGGAAGAGATCCTGGCCGAGGGCGACCGGGTGCTGTGTTTTACCCAGTTC
ACCGAGTTCGCCGAGCTGCTGGTGCCGCACCTGGCCGCACGCTTCGGCCGTGCCGCCCGAGACATT
GCCTACCTGCACGGTGGCACCCCGAGGAAGCGGCGTGACGAGATGGTGGCCCGGTTCCAGTCCGGT
GACGGCCCGCCCATTTTTCTGCTGTCGTTGAAGGCGGGCGGTACCGGGCTGAACCTCACCGCCGCC
AATCATGTTGTGCACCTGGACCGCTGGTGGAACCCGGCGGTCGAGAACCAGGCGACGGACCGGGCG
TTTCGGATCGGGCAGCGGCGCACGGTGCAGGTCCGCAAGTTCATCTGCACCGGCACCCTCGAGGAG
AAGATCGACGAAATGATCGAGGAGAAAAAGGCGCTGGCCGACTTGGTGGTCACCGACGGCGAAGGC
TGGCTGACCGAACTGTCCACCCGCGATCTGCGCGAGGTGTTCGCGCTGTCCGAAGGCGCCGTCGGT
GAGTAG

FIGURE 10 (continued)

SEQ ID NO: 52, Mycobacterium tuberculosis H37Rv Myctu_SNF2 translated polypeptide

MLVLHGFWSNSGGMRLWAEDSDLLVKSPSQALRSARPHPFAAPADLIAGIHPGKPATAVLLLPSLR
SAPLDSPELIRLAPRPAARTDPMLLAWTVPVVDLDPTAALAAFDQPAPDVRYGASVDYLAELAVFA
RELVERGRVLPQLRRDTHGAAACWRPVLQGRDVVAMTSLVSAMPPVCRAEVGGHDPHELATSALDA
MVDAAVRAALSPMDLLPPRRGRSKRHRAVEAWLTALTCPDGRFDAEPDELDALAEALRPWDDVGIG
TVGPARATFRLSEVETENEETPAGSLWRLEFLLQSTQDPSLLVPAEQAWNDDGSLRRWLDRPQELL
LTELGRASRIFPELVPALRTACPSGLELDADGAYRFLSGTAAVLDEAGFGVLLPSWWDRRRKLGLV
LSAYTPVDGVVGKASKFGREQLVEFRWELAVGDDPLSEEEIAALTETKSPLIRLRGQWVALDTEQM
RRGLEFLERKPTGRKTTAEILALAASHPDDVDTPLEVTAVRADGWLGDLLAGAAAASLQPLDPPDG
FTATLRPYQQRGLAWLAFLSSLGLGSCLADDMGLGKTVQLLALETLESVQRHQDRGVGPTLLLCPM
SLVGNWPQEAARFAPNLRVYAHHGGARLHGEALRDHLERTDLVVSTYTTATRDIDELAEYEWNRVV
LDEAQAVKNSLSRAAKAVRRLRAAHRVALTGTPMENRLAELWSIMDFLNPGLLGSSERFRTRYAIP
IERHGHTEPAERLRASTRPYILRRLKTDPAIIDDLPEKIEIKQYCQLTTEQASLYQAVVADMMEKI
ENTEGIERRGNVLAAMAKLKQVCNHPAQLLHDRSPVGRRSGKVIRLEEILEEILAEGDRVLCFTQF
TEFAELLVPHLAARFGRAARDIAYLHGGTPRKRRDEMVARFQSGDGPPIFLLSLKAGGTGLNLTAA
NHVVHLDRWWNPAVENQATDRAFRIGQRRTVQVRKFICTGTLEEKIDEMIEEKKALADLVVTDGEG
WLTELSTRDLREVFALSEGAVGE

SEQ ID NO: 53, Myxococcus xanthus DK 1622 Myxxa_DK_SNF2 nucleic acid sequence

GTGCGAGCCTGGAGGGGCGTCCTCCGCTGGGCTGCCGCTGGCCTCTCCCTGTCCGCGGCTCGGAGT
CCGACCGGCCACCTCCCAGTGTTTTCAGGTTTTTCCGTGGCGACCGATGGCGTCGGGCTGTTCGCG
GGTCTGTCTGTTCGGGCCCTTGTCCATCAAGGGCCTGGAGGAGGACCGCTACGAGCGCCTCACGGA
CAACCCGGCAGGCCTGCGGCTCACGGAGCCGGCAATCCCGTGCAGGGGCGCTCGCAGGCCTGCTTG
CGTGTGCCGCTTGCCCGGACGGAGTTTACATTCGCAGCGATGCCCCTCGTGTTCCTGCCCGACGCC
GAGACGCTGTTCCTCTGGGGGCCCGACCGGCTGCCACGTGAGCTCGCCGGCCTGCCGGAGACGGGG
GACCGCGCCTCCGCGCTGCTCGTGACGCCCGAGGGATTGCGTGAATGCGAGGGGCACGGGCTGCCC
CTGGCCGCCACCGTCGAGCGGCTCGCGGTGGTGCAAACCTCCGAGGCCGAGTCCTTTCCTGGCTCC
ATCGCCCTGTGGACGCTGGCCAGCAAGCTCGCGCTGGAGTTGGTGGCGCGCGAGCGCGTGGTGCCC
ACGCTCCTGCGGCGGGGCGAGCGCATCGAGGCTCGCTGGGCGGCGGCCCTCTCCGCCACCGAGGAC
GCCGGCCGCGTCGCCGCGCTCGCCCGGAGCATGCCGCCCGGCGCGCACGCCGTCCCCGCAGGCGCC
AGGCCAGGCCGCGCCGTCTGGGCCCCGGACGCCTTGCTGCGCGCCTTCCTCGACGCCACCGTCGAC
GCCTTCGTGCGCGCCGCGCGCGGTGCGCCTTCGTTGCCGGCCCGGCGCGCGGCCTCGTGGGACGAG
CGCTGGCGCGAGGCGCTCACCGGCGCGCGACGCGACTTCGCGCCGGAGGGCTTCGCCGAGCGCTCC
GTCGTCGATGAGCTGACGCGCTGGAGCGAACCCGCGCTCGGCGCCCGGGACAAGCTGCGCGCCTGC
TTCCGGCTGGAGCCCCCGACGGAGGAGCGCGAGCCCTTCGTGCTGAGCTTCCACCTCCAGTCCCCG
GACGACCCAAGCCTGCTCGTCCCGGCCGCGGACGTCTGGAAGACGCGCGGGCGCAGCCTGGAGAAG
CTCGGCCGCGCCTTCCGTGACCCGCAGGAGTCCCTGCTCGAGGCACTCGGCCGCGCCGCCCGGCTC
TTCCCCCCGCTGGCGCTCGTGCTGGAGAGCCCACGTCCCCAGGCGCTCCTGCTCGAGCCCGACACC
GCGTGGACGTTCCTCTCGGAGGGCGCCCGCGTGCTCTCAGACGCCGGCTTCGGCGTCATCGTCCCT
GGCGAGCTCACCACCTCGGGCCGACGCCGCCTGCGCCTGCGCATGCGCGTGGGCGCGAGCACGAAG
GCCGCGGGGGCCGTCGGTGGCACCGCGGGGCTCGGGCTCGACGCGCTGCTGCGCGTGGACTGGGAC
GCCGTGCTGGGCGACCAACCCCTCTCCGCCCAGGAGCTGGCGCTGCTGGCCCAGCGCAAGGCCCCG
CTCGTGCGATTCCGCGGCGAGTGGGTCGCGGTGGATCCCCTCGAACTCGACGCCATCCAGCGCCAC
CTCGCCCAGGGCCCCGGCCGCATGGCGCTGAGCGAGGCGGTGCGGGTGTCCCTGCTAGGCGAAACG
CGCCACGGACAGCTCCCCGTCACCGTTCTCGCCACCGGGGCGCTGGAGGAGCGCCTGCGCCTGCTT
CGGGAGGGCGGGGCCACCGCTCAGGACGCCCCCCGCGCGCTGCGCGCCACGCTGCGGCCCTACCAG

FIGURE 10 (continued)

TCGCGCGGTCTGCACTGGCTGGACACGCTGGCCTCATTGGGGCTCGGCGCCTGCCTCGCGGACGAC
ATGGGCCTGGGCAAGACGGTGCAGGTGCTGGCCTTCCTGCTGCGGCGGCTCGAGCAGGCGCCTGAC
GAGGCGCGCCCCACGCTGCTGGTGGCCCCCACCTCCGTGGTGGGCAACTGGGAGCGTGAGCTCGCC
CGCTTCGCCCCCACCTTGCGCCTGACGCGGCACTACGGCGCCGAGCGCGCCCGCGCGGCGAACCGC
TTCCCCCGCGCGCCCGGCGCCGTCGTGCTCACCACCTACGGCTTGCTGCGCCGGGACGCCGCGCTG
CTCGCGCGCGTGGACTGGGGCGCGGTGGTGCTCGACGAGGCGCAGAACATCAAGAACGCGGCGTCG
GCTACCGCCCGCGCGGCCCGGGCGTTGCGCGCCAGCCAGCGCTTCGCGCTCACGGGCACGCCGGTG
GAGAACCGCCTGGCGGAGCTGTGGTCCATCCTCGAGTTCGCCAACCCGGGCCTGCTCGGGCCGCTG
GAGACGTTCCGGCGGGAGCTGGCGCTGCCCATTGAACGCCATGGCAATCAGGAGGCCTCGGCCCGG
CTGCGCCGGCTCGTGAGCCCCTTCGTCCTGCGCCGCCTCAAGAGCGACCCGACCATCATCACGGAC
CTGCCCGCGAAGAATGAGATGAAGGTCGTCTGCACGCTCACGCGCGAGCAGGCCTCGCTCTACAAG
GCGGTGGTGGACGAGGAGCTGCGGCGCATCGAGGAGGCCGACGGCATGGAGCGCCGGGGCCGCGTG
CTCGCGCTGCTGCTGTACACGAAGCAGATCGCCAACCACCCGGCGCAGTACCTCGGGGAGTCCGGG
CCCCTGCCGGGGCGCTCGGGGAAGCTGGCGCGCGTGGTGGAGATGCTCGAGGAGTCCCTGGCCGCT
GGCGACAAGGCGCTCGTCTTCACGCAGTTCCGGGAGATGGGCGACAAGCTGGTGGCGCACCTGTCG
GAGTACCTGGGCCACGAGGTGCTCTTCCTCCACGGCGGCACGCCCCGCAAGGCGCGCGACGAGATG
GTGCGGCGCTTCCAGGAGGACGTCCACGGTCCGCGTGTGTTCGTGCTGTCCGTCAAGGCGGGAGGC
ACGGGGCTCAACCTGACGGCGGCGAGCCATGTGTTCCATTACGACCGCTGGTGGAACCCGGCCGTC
GAGGACCAGGCCACCGACCGCGCGTACCGCATCGGGCAGACGCGCGCGGTGCAGGTCCACAAGCTG
GTGTGTGCGGGCACTGTCGAGGAGAAGGTGGACCGGCTGCTCGAACAGAAGCGCCAGCTCGCCGAG
AAGGTCGTGGGCGCGGGCGAGCACTGGGTGACCGAGCTGGACACGACGGCGCTGCGCGAGCTGTTC
TCGCTGTCCGAGGGCGCCGTGGCGGACGATGGCGACGCGGAAGGGGAAGACGACGCGCGGGTGCGC
GCCCCGCGACGGCGCGGCCGTGCGAGCGCGAAGGCGGTGTCGCGATGA

SEQ ID NO: 54, Myxococcus xanthus DK 1622 Myxxa_DK1622_SNF2 translated polypeptide

VRAWRGVLRWAAAGLSLSAARSPTGHLPVFSGFSVATDGVGLFAGLSVRALVHQGPGGGPLRAPHG
QPGRPAAHGAGNPVQGRSQACLRVPLARTEFTFAAMPLVFLPDAETLFLWGPDRLPRELAGLPETG
DRASALLVTPEGLRECEGHGLPLAATVERLAVVQTSEAESFPGSIALWTLASKLALELVARERVVP
TLLRRGERIEARWAAALSATEDAGRVAALARSMPPGAHAVPAGARPGRAVWAPDALLRAFLDATVD
AFVRAARGAPSLPARRAASWDERWREALTGARRDFAPEGFAERSVVDELTRWSEPALGARDKLRAC
FRLEPPTEEREPFVLSFHLQSPDDPSLLVPAADVWKTRGRSLEKLGRAFRDPQESLLEALGRAARL
FPPLALVLESPRPQALLLEPDTAWTFLSEGARVLSDAGFGVIVPGELTTSGRRRLRLRMRVGASTK
AAGAVGGTAGLGLDALLRVDWDAVLGDQPLSAQELALLAQRKAPLVRFRGEWVAVDPLELDAIQRH
LAQGPGRMALSEAVRVSLLGETRHGQLPVTVLATGALEERLRLLREGGATAQDAPRALRATLRPYQ
SRGLHWLDTLASLGLGACLADDMGLGKTVQVLAFLLRRLEQAPDEARPTLLVAPTSVVGNWERELA
RFAPTLRLTRHYGAERARAANRFPRAPGAVVLTTYGLLRRDAALLARVDWGAVVLDEAQNIKNAAS
ATARAARALRASQRFALTGTPVENRLAELWSILEFANPGLLGPLETFRRELALPIERHGNQEASAR
LRRLVSPFVLRRLKSDPTIITDLPAKNEMKVVCTLTREQASLYKAVVDEELRRIEEADGMERRGRV
LALLLYTKQIANHPAQYLGESGPLPGRSGKLARVVEMLEESLAAGDKALVFTQFREMGDKLVAHLS
EYLGHEVLFLHGGTPRKARDEMVRRFQEDVHGPRVFVLSVKAGGTGLNLTAASHVFHYDRWWNPAV
EDQATDRAYRIGQTRAVQVHKLVCAGTVEEKVDRLLEQKRQLAEKVVGAGEHWVTELDTTALRELF
SLSEGAVADDGDAEGEDDARVRAPRRRGRASAKAVSR

FIGURE 10 (continued)

SEQ ID NO: 55, Nocardia farcinica IFM 10152 Nocfa_IFM\10152_SNF2 nucleic acid sequence

ATGGTGGGCGCCGGCGGCCCGCCGGGTGTCGGTGCCACCTGCTTGGATGGACGGATGCTGCACGGA
CTGTGGTCGCCGGGTTCCGGCCTGGTGCTGTGGACCGAGGGCGAGGTGCCGCCCGCGCTGCCCGAC
CCGGCCGGTGCGTTGCTGCGCGCATCGCGGTTCCGGCATCGGGCGCAGGTGCTGGTGCCGGGCCCC
GCCGGCCCACAGCTCACGCAGGTGCGCGCGCACGCCCTGGTGCCACAGGCCGCGGTCGACGTGCTG
CGGCAGCGGTTACCCGTCGAATCGGTGGCGGGTGACCTGCGCTTTCTCGCTCACGTCGCCGACGGG
ATCGATCGGTGGGTGCGGGCCGGTCGCGTGGTGCCCGACCTGCACCGGGCCGACGGACAGTGGTGG
GCGCGCTGGCGGCTGGTCGGCGGTGCCCGGCAGCGGGCCTGGCTGGCCGAACTCGCGGTGGCGATG
CCCGCGGCGCTGCGGGTGGCCGGGCAGCCCGCGGCGGTGCTCGACGATCTGGTCACCGAGCTGACC
GATCCGATCGTGCGCACCAGGCTCGCCGACGCGCCGGTGACGCACCCGCTGGTGCGCGCACTGGTG
CGGGACCAGCCGCTCGAGACGGGTAGCCACCAGCTGGCCGAGGTGCTGCGGCGCTGGCGCGAGAGC
CTCACCGTCGACGAGCCGGAGCTGGTGTTGCGGCTGCTGGAACCGGACGGGGAGACCGGTATCGAC
GGGGACGGCGGGGACGACCGGGACGACACCGTGGCGCTGTGGCGGCTGGAGGTCTGCCTCCGCACC
GAGGGCGAGGCCCCGGCCCCGGTGCCGGCGACCGCCGACCCGAACCTGCTGCGCATCGCCGTCGAG
CAGCTCGGCCGGGCGCAGCGGGCCTACCCCCGGCTGCGCGATCTGCCCGGCGATCCGCACAGCCTC
GACCTGCTGTTGCCCACCGAGGTGGTGGCCGATCTCGTCGCGCACGGTGCGCAGGCGTTGCGCGAG
GCGGGGGTGCGGCTGCTGCTGCCGCGCGCCTGGACCATCGCCGAACCCACCCTGCGGCTCGCGGTG
AGCAGCGCCGCGCCCGCCGCGGAGAGCACCGTGGGCATGCAGGGTCTGCTGTCCTATCGGTGGGAA
CTGGCGGTCGGCGACAAGGTGCTCACCCGCGCCGAGATGGAGCGCCTGGTCCGCGCCAAATCCGAC
CTGGTGCAGTTGCGCGGGGAATGGGTGCAGGCCGACCACAAGGTGCTCGCCGCCGCCGCCCGCTAC
GTCGCCGCGCATCTGGACACGTCGCCGGTCACCCTCGCCGACCTGCTCGGCGAGATCGCCGCCACC
CGCGTCGACAAGGTGCCGCTCACCGAGGTCACCGCCACCGGCTGGGCGGGCGAGTTGTTCGACGGC
GGCCGCGAGCCGGTGGCGACCCCGGGTGGGCTGAAGGCGCAGCTGCGCCCGTATCAGCTGCGCGGC
CTGAGCTGGCTGGCGACGATGAGCCGGATGGGCTGCGGCGGCATCCTCGCCGACGACATGGGTCTC
GGCAAGACGGTGCAGGTGCTGGCCCTGCTGGTGCACGAGCGCGAGACCAGCACGGCACCGCCCGGC
CCGACACTGCTGGTGTGCCCGATGTCGGTGGTCGGCAACTGGCAGCGCGAGGCGCAGCGGTTCGCC
CCCGGGCTGCGGGTGCTGGTGCACCACGGCGCCGACCGCCGTCGCGACGCCGAACTCGATGCCGCG
GTGGCGGATTCGGACCTGGTGCTCACCACCTACGCCATCCTGGCCAGGGATGCGGCCGAACTGTCG
CGCCAGTCGTGGGACCGGGTGGTGCTCGACGAGGCGCAGCACATCAAGAACGCCGCGACCAGGCAG
GCACGTGCCGCCCGTGCCCTGCCGGCCCGGCATCGCCTGGCGCTCACCGGAACCCCGGTGGAGAAC
CGGCTCGAAGAGTTGCGCTCGATCATGGATTTCGCGGTGCCCAAGCTGCTCGGTACCGCACCGACC
TTCCGCGCCCGGTTCGCCGTCCCCATCGAACGCGGGCAGGATCCCAACGCCCTGTCCCGCCTGCGC
TTCCTCACCCAACCGTTCGTGCTGCGCCGGGTCAAGGCCGATCCGGCGGTCATCGGCGATCTGCCC
GACAAGCTCGAGATGACGGTGCGGGCGAACCTGACCGTCGAGCAGGCCGCCCTGTACCAAGCCGTC
GTCGACGACATGCTGGTGAAACTGCGCAGTGCCAAGGGCATGGCCCGCAAGGGTGCGGTGCTCGGC
GCGCTCACCCGGCTCAAGCAGGTGTGCAACCATCCCGCGCACTTCCTCGGTGACGGTTCCCCGGTG
CTGCATCGCGGCAGGCACCGCTCCGGCAAGCTCGCCTTGGTCGAGGACGTGCTCGACACCGTCGTC
GCGGACGGGGAGAAGGCGTTGCTGTTCACCCAGTTCCGTGAGTTCGGCGACCTGCTCGCGCCCTAT
CTGTCCGAGCGGTTCGGCGCGCCGATCCCGTTCCTGCACGGCGGCGTGACCAAGAAGAACCGGGAC
ACGATGGTCGAGCGCTTCCAGTCCGGCGACGGCCCGCCGGTCATGCTGCTGTCCCTCAAGGCCGGC
GGCACCGGGCTCACCCTCACCGCCGCCAATCACGTGGTGCACCTGGATCGCTGGTGGAATCCGGCG
GTGGAGAACCAGGCCACCGATCGCGCCTTCCGCATCGGCCAGCGCCGCGACGTCCAGGTGCGCAAG
CTGGTCTGCGTCGACACCATCGAGGAACGGATCGACGAGATGATCACCGGCAAGAGCAGGCTCGCG
GACCTGGCCGTGGACGCGGGGGAGAACTGGATCACCGAGCTGGGCACCGAGGAGCTGCGCGAGTTG
TTCACCCTCGGCGCCGAGGCGGTGGGGGAGTGA

FIGURE 10 (continued)

SEQ ID NO: 56, Nocardia farcinica IFM 10152 Nocfa_IFM_10152_SNF2 translated polypeptide

MVGAGGPPGVGATCLDGRMLHGLWSPGSGLVLWTEGEVPPALPDPAGALLRASRFRHRAQVLVPGP
AGPQLTQVRAHALVPQAAVDVLRQRLPVESVAGDLRFLAHVADGIDRWVRAGRVVPDLHRADGQWW
ARWRLVGGARQRAWLAELAVAMPAALRVAGQPAAVLDDLVTELTDPIVRTRLADAPVTHPLVRALV
RDQPLETGSHQLAEVLRRWRESLTVDEPELVLRLLEPDGETGIDGDGGDDRDDTVALWRLEVCLRT
EGEAPAPVPATADPNLLRIAVEQLGRAQRAYPRLRDLPGDPHSLDLLLPTEVVADLVAHGAQALRE
AGVRLLLPRAWTIAEPTLRLAVSSAAPAAESTVGMQGLLSYRWELAVGDKVLTRAEMERLVRAKSD
LVQLRGEWVQADHKVLAAAARYVAAHLDTSPVTLADLLGEIAATRVDKVPLTEVTATGWAGELFDG
GREPVATPGGLKAQLRPYQLRGLSWLATMSRMGCGGILADDMGLGKTVQVLALLVHERETSTAPPG
PTLLVCPMSVVGNWQREAQRFAPGLRVLVHHGADRRRDAELDAAVADSDLVLTTYAILARDAAELS
RQSWDRVVLDEAQHIKNAATRQARAARALPARHRLALTGTPVENRLEELRSIMDFAVPKLLGTAPT
FRARFAVPIERGQDPNALSRLRFLTQPFVLRRVKADPAVIGDLPDKLEMTVRANLTVEQAALYQAV
VDDMLVKLRSAKGMARKGAVLGALTRLKQVCNHPAHFLGDGSPVLHRGRHRSGKLALVEDVLDTVV
ADGEKALLFTQFREFGDLLAPYLSERFGAPIPFLHGGVTKKNRDTMVERFQSGDGPPVMLLSLKAG
GTGLTLTAANHVVHLDRWWNPAVENQATDRAFRIGQRRDVQVRKLVCVDTIEERIDEMITGKSRLA
DLAVDAGENWITELGTEELRELFTLGAEAVGE

SEQ ID NO: 57, Nodularia spumigena Nodsp_SNF2 nucleic acid sequence

ATGGCAATTTTACACGGTAATTGGTTAGTAAGAAATCAAAATGGTTGTTTATTTATTTGGGGTGAA
ACTTGGCGTTCATCACGAGTCGATTTTGCTCTGAATGTATCTCAAGATATACCACTACATCCATTG
GTAATGTCACCAATTGATTTGAGTGAGTTGTTAAGTTATCATAATATCAAAATTCCTAGCTTAATA
CAGCAATCCCAAGTTGCTTTATCTGGCACTGGGCGAACTCGTAAAAGTACAAGTACTACTAAATTT
AGCTGGACAACTCACTCTCTAATCATTGATTTACCAACTCATATCTCAGAAAATAATCCCCAAGAA
ATAGAATTTATTTCCCCTTTGCATTCTGCTACTTTGGGTTCTGAAATAAATTCACCCCAATATCTC
CAACCGTGGCGAGTCGAGGGTTTTTGTCTCAACCCCACTGAAGCGATAAAATTTCTCGCTGCTGTT
CCTTTAAATGCTGCTAGAGAAGAAGATACTTTGTTCGGTGGAGATTTACGTTTTTGGTCACAAATT
GCCCGTTGGAGTTTGGATTTAATCTCTCGGTGTAAGTTTTTGCCAACTATTCAAAGACAGTTTGAT
AGTTCTATTGTTGCTAGGTGGCAAGTGCTTTTAGACAGTGCAATAGATGGAACACGCCTGGAAAAA
TTTTCTGCAAAAATGCCATTAGCTTGTCGTACTTATCGGAAGGGAATGGGGAGTGGGGAGTGGGGA
GTGGGGAGTGGGGAGGAATCTTCCCCATCCATAATGTATGTAGATTTTCCAACTGAACCCCAGGAA
CTATTATTAGGATTTCTCAACAGTACCATAGATGCCCAAGTGCGAGAAATGTTAGCTTCTCAACCT
CTACTAGAAACTAGAGTGATGGCATCTTTACCATCTGCGGTGCGACAGTGGTTGCAAGGTTTAACC
AGTGCATCTCACACAGTGAATGCAGATGCAATGGAAGTAGAAAGATTAGAAGCAGCCCTGAAATCT
TGGACTATGCCGTTGCAATATCAACTGGTAGGAAAACCCTCGTTTCGCGCCTGTTTTCAACTGCTT
CCCCCTGCTTCTGGGGCAACAGATTGGATATTGGCATATTTTCTCCAAGCTGCGGATGATGAAAAT
TTATTAGTGGATGCGGCAACTATTTGGCATCACCCAGTTGAACAATTAGTTTATCAAAATCGCACC
ATTGATCAACCCCAAGAAACTTTATTGCGGGGCTTGGGTTTAGCTTCGCGATTATATCCAGTTCTT
ACACCGAGTTTAGAAACAGAATATCCCCAATGTTGTCGCCTCAACCCATTACAAGCTTATGAATTT
ATCAAGTCTGTAGCTTGGCGATTTGAAGATAGTGGTTTGGGGGTAATTTTACCTCCTAGTTTGACT
AACCGCGAAGGATGGGCGAACCGTTTGGGGTTAAAAATTAGTGCTGAAACTCAAAAGAAAAAACAG
GGACGCTTGGGTTTACAAAGTTTACTGAATTTTCAATGGCAATTGGCAATTGGTGGACAAACAATT
TCTAAAACCGAGTTTAATAAACTGGTAGCTTTAAATAGCCCACTGGTAGAAATTAACGGCGAATGG
GTGGAATTGCGACCCCAGGATATTAAAACAGCACAGACATTTTTTGCTTCTCGTAAAGACGAAATG
ACGCTTTCTTTGGAAGATGCTTTACGCCTCAGTTCTGGCGATACCCAAGCGATTGAAAAGTTACCT
GTGGTCAGTTTTGAAGCATCTGGGACATTGCAAGAGTTAATTGGGGCGTTAACCAATAATCAAGCC
ATTTCACCCCTCCCAACACCTGCAAATTTTCAAGGACAGTTACGACCTTATCAAGAAAGAGGGGCG

FIGURE 10 (continued)

GCTTGGCTGGCTTTCTTAGAACGTTGGGGTTTAGGTGCTTGTTTGGCTGATGATATGGGGCTGGGA
AAAACAATTCAGTTAATTGCCTTTTTACTGCACCTCAAAGAACAAGACGCACTGGAAAATCCCACA
TTACTTGTTTGTCCGACTTCTATTTTAGGTAACTGGGAACGGGAAATTAAAAAATTTGCTCCTACT
CTCAAAGTTTTACAGCACCACGGCGATAAACGTCTCAAAGGTAAAGCGTTTGTAGAAGCAGTCAAA
AAACACGATGTAATTATTACCAGTTACTCACTCGTTCACCGGGATATTAAATCTTTGCAGAGTGTC
GATTGGCAAACAGTTGTATTAGATGAAGCCCAGAATGTGAAAAATCCTGAAGCTAAACAATCGCAG
GCTGTGAGGGGATTAAAAACTACATTTCGCATAGCTTTAACAGGGACACCAGTAGAAAACAAACTG
CAAGAATTGTGGTCTATTTTAGATTTTCTTAATCCTGGGTATTTGGGAAATCGTCAATTTTTCCAG
AGACGGTTTGCTATGCCAATTGAAAAGTATGGTGATACAGCATCTTTAAATCAATTGCGGGGTTTA
GTTCAACCGTTTATTCTACGTCGTCTGAAAACAGATCGTGATATTATTCAAGATTTGCCAGAAAAG
CAAGAAATGACGGTTTTTTGTGGGCTTGCGGCTGAACAAGCTGCACTTTATCAACAAGTAGTTGAA
GCATCTTTAGTAGAAATTGAATCTGCTGAGGGTTTGCAACGTCGAGGGATGATTTTAGCTTTACTT
GTGAAACTTAAACAAATCTGTAATCATCCAGCCCAATATTTGAAAGCCGCGACATTACAAGAACAT
AGTTCTGCTAAACTGCAACGGCTAGATGAAATGTTAACGGTAGCTTTGGAGGAAGGAGATAGGGCT
TTAATTTTCACTCAATTTGCTGAATGGGGTAAGTTATTAAAAGCTCATTTACAACAAACACTTGGG
AAAGAAATATTCTTTTTATATGGTGGTAGCAGTAAAAAACAACGCGAGGAAATGATTGACCGTTTC
CAACATGACCCCCAAGGACCTCCGATTATGATTCTTTCTTTAAAAGCGGGTGGGGTAGGCTTGAAT
TTAACCAGGGCTAATCATGTATTTCACTTTGATAGATGGTGGAATCCCGCAGTGGAAAATCAAGCG
ACAGATAGAGTATTTCGTATTGGTCAAACCCGGAATGTGCAAGTGCATAAATTTGTCTGTACTGGC
ACATTAGAAGAAAAAATTCATGACATGATTGAAAGTAAAAAACAATTAGCGGAACAAGTAGTTGGT
GCTGGTGAGGAGTGGCTGACTGAAATGAATACTGACCAATTGCGTGATTTACTCATTCTTGATCGC
AGTGCCATAATTGATGAGGATGAAGTTTAA

SEQ ID NO: 58, Nodularia spumigena Nodsp_SNF2 translated polypeptide

MAILHGNWLVRNQNGCLFIWGETWRSSRVDFALNVSQDIPLHPLVMSPIDLSELLSYHNIKIPSLI
QQSQVALSGTGRTRKSTSTTKFSWTTHSLIIDLPTHISENNPQEIEFISPLHSATLGSEINSPQYL
QPWRVEGFCLNPTEAIKFLAAVPLNAAREEDTLFGGDLRFWSQIARWSLDLISRCKFLPTIQRQFD
SSIVARWQVLLDSAIDGTRLEKFSAKMPLACRTYRKGMGSGEWGVGSGEESSPSIMYVDFPTEPQE
LLLGFLNSTIDAQVREMLASQPLLETRVMASLPSAVRQWLQGLTSASHTVNADAMEVERLEAALKS
WTMPLQYQLVGKPSFRACFQLLPPASGATDWILAYFLQAADDENLLVDAATIWHHPVEQLVYQNRT
IDQPQETLLRGLGLASRLYPVLTPSLETEYPQCCRLNPLQAYEFIKSVAWRFEDSGLGVILPPSLT
NREGWANRLGLKISAETQKKKQGRLGLQSLLNFQWQLAIGGQTISKTEFNKLVALNSPLVEINGEW
VELRPQDIKTAQTFFASRKDEMTLSLEDALRLSSGDTQAIEKLPVVSFEASGTLQELIGALTNNQA
ISPLPTPANFQGQLRPYQERGAAWLAFLERWGLGACLADDMGLGKTIQLIAFLLHLKEQDALENPT
LLVCPTSILGNWEREIKKFAPTLKVLQHHGDKRLKGKAFVEAVKKHDVIITSYSLVHRDIKSLQSV
DWQTVVLDEAQNVKNPEAKQSQAVRGLKTTFRIALTGTPVENKLQELWSILDFLNPGYLGNRQFFQ
RRFAMPIEKYGDTASLNQLRGLVQPFILRRLKTDRDIIQDLPEKQEMTVFCGLAAEQAALYQQVVE
ASLVEIESAEGLQRRGMILALLVKLKQICNHPAQYLKAATLQEHSSAKLQRLDEMLTVALEEGDRA
LIFTQFAEWGKLLKAHLQQTLGKEIFFLYGGSSKKQREEMIDRFQHDPQGPPIMILSLKAGGVGLN
LTRANHVFHFDRWWNPAVENQATDRVFRIGQTRNVQVHKFVCTGTLEEKIHDMIESKKQLAEQVVG
AGEEWLTEMNTDQLRDLLILDRSAIIDEDEV

FIGURE 10 (continued)

SEQ ID NO: 59, Nostoc sp. PCC7120 Nos_sp_PCC7120_SNF2 nucleic acid sequence

ATGGCAATTCTACACGGTAGTTGGATATTAAATGAGCAGGAGAGTTGTTTATTTATTTGGGGGGAA
ACTTGGCGATCGCCACAAGTGGATTTTAATTTTGCGGAGATATCCCTCAATCCCTTGGCGCTGTCT
GCACTGGAATTAAGTGAGTGGTTGCAGTCTCAACATCAGGCGATCGCTAAGTTGTTACCGCAACAA
TTGGAAAAACGAACCTCCAAAGCAGCAAGTTCTGTAAAAATAAATTTATTAACTCATTCACAAATA
ATTGCCCTGCCAACGGAAATTTCCCAACCTCGTAAAAAAGAAACCATTTTAATTTCTCCTGTGCAT
TCTGCCGCTTTAGCATCTGAGTCAGACTCTGAAGTTTATTTACAAACTTGGCGTGTAGAAGGTTTT
TGTCTTCCTCCTAGTGCAGCAATTAAATTGCTAACTTCTTTACCTTTAAATATAACTAGTGGGGAG
AATGCTTTTTTAGGTGGAGATTTACGTTTCTGGTCACAAATTGCCCGTTGGAGTTTAGATTTAATT
TCTAGGTCTAAGTTTCTCCCAATTATCCAACGACAACCTAATAATTCTGTAAGTGCTAAATGGCAA
GTACTTTTAGATAGTGCCGTAGATGGAACTCGTTTAGAAAAGTTTGCTGCGAAGATGCCCTTGGTT
TGTCGGACTTATCAAGAAATTGGGAGTGGGGAATCTCCTATATATATAGATTTTCCTAGTCAGCCG
CAGGATTTAATCTTGGGTTTTCTCAATAGTGCGATAGATACGCAATTGCGGGAGATGGTGGGGAAT
CAGCCTGTGGTGGAAACTCGGTTGATGGCATCTTTACCATCGGCGGTGCGACAGTGGTTGCAAGCG
TTAATTGCTGCATCTAATTCAATTGATGCAGATGCTGTTGGTTTAGAAAGGCTGGAAGCGGCGCTC
AAGGCTTGGACGATGCCGCTACAATATCAACTAGCAAGTAAAAATCAATTTCGCACTTGTTTTGAA
TTACGTTCTCCAGAACCAGACGAAACTGAATGGACGCTGGCGTATTTCCTGCAAGCAGCCGATGAT
CCAGAATTTTTAGTAGATGCGGCGACTATTTGGCAAAATCCTGTTGAACAGCTAATTTATCAACAG
CGAACGATTGAAGAACCCCAGGAAACGTTTTTGCGAGGTTTGGGGTTAGCTTCTCGATTGTATCCG
GTCATTGCCCCCACTTTAGATACAGAATCACCCCAATTTTGTCATCTCAAGCCCATGCAGGCTTAT
GAATTTATCAAGGCTGTGGCTTGGCGATTTGAAGATAGCGGCTTAGGGGTGATTTTACCTCCTAGT
TTGGCGAATCGTGAAGGCTGGGCAAATCGCTTGGGTTTGAAAATCTCCGCCGAAACGCCGAAGAAA
AAACCAGGACGCTTAGGATTGCAGAGTTTGCTCAATTTCCAATGGCACTTAGCGATTGGTGGGCAA
ACTATTTCTAAAGCTGAATTTGACAGACTGGTAGCTTTAAAAAGCCCATTGGTAGAAATTAACGGC
GAGTGGGTGGAATTACGTCCCCAAGATATCAAAACAGCTGAAGCCTTTTTTACTGCGCGTAAAGAC
CAAATGGCCTTATCTTTAGAAGATGCCTTACGTCTAAGTAGTGGCGATACACAAGTAATTGAGAAA
TTACCAGTAGTCAGCTTTGAAGCCTCTGGCGCATTACAAGAATTGATTGGGGCGCTGACAAATAAT
CAAGCAGTTGCACCATTACCTACGCCGAAAAACTTCCAAGGACAGTTACGTCCTTATCAAGAAAGG
GGTGCGGCTTGGTTGGCGTTCCTCGAACGCTGGGGTTTAGGTGCTTGTCTCGCCGACGACATGGGA
CTGGGAAAAACGATACAGTTCATTGCTTTCCTTCTCCATCTTAAAGAACAGGATGTATTAGAAAAA
CCAACTTTACTAGTGTGTCCTACTTCTGTTTTAGGTAACTGGGAACGAGAGGTGAGAAAATTTGCA
CCTACACTTAAAGTTCTCCAGTATCATGGTGACAAACGTCCTAAAGGTAAAGCATTTCAAGAAGCA
GTAAAAAAACATGATTTAGTTATTACAAGTTACTCATTAATTCATAGAGATATCAAATCATTGCAG
GGTATTCCTTGGCAAATAATTGTTTTAGATGAAGCCCAAAATGTGAAGAATGCGGAAGCCAAACAA
TCACAAGCAGTCAGACAATTAGAAACAACATTTCGTATTGCTTTAACAGGTACACCAGTAGAAAAT
AGACTACAAGAACTTTGGTCAATTTTAGATTTTCTTAATCCTGGTTACTTAGGTAATAAGCAATTC
TTTCAAAGACGTTTTGCTATGCCAATTGAAAAGTATGGTGATGCAGCATCTTTAAATCAATTGCGT
GCTTTAGTGCAACCATTTATTCTGCGTCGGCTGAAAACAGACCGTGATATTATTCAAGACTTGCCC
GATAAGCAAGAAATGACAGTATTTTGTGGTTTGACTGGAGAACAAGCTGCACTTTATCAAAAAGCG
GTAGAAACATCTTTAGCAGAAATTGAATCAGCCGAAGGATTGCAACGCCGAGGGATGATTTTAGCT
TTATTAATTAAACTCAAACAAATCTGCAATCATCCAGCCCAATATCTGAAAATAAATACATTAGAA
CAACACAGTTCTGGAAAACTGCAAAGATTAGAAGAAATGTTAGAAGAGGTGTTAGCAGAGAGTAAT
ACTTACGGTGTTGCCGGTGCGGGACGTGCTTTGATTTTTACCCAATTTGCAGAATGGGGTAAGTTA
CTCAAACCACATTTAGAAAAACAACTAGGGCGGGAAATATTTTTCTTATATGGTGGTACGAGTAAA
AAGCAACGAGAAGAAATGATTGACCGTTTTCAACACGACCCCCAAGGGCCACCAATTATGATTCTC
TCCCTCAAAGCAGGTGGTGTAGGGTTGAACTTAACCAGGGCAAATCATGTATTTCACTTTGATAGA

FIGURE 10 (continued)

TGGTGGAATCCAGCCGTAGAGAATCAAGCTACAGACCGCGTATTTCGCATTGGTCAAACTCGCAAT
GTACAGGTGCATAAATTTGTTTGTAATGGCACCTTAGAAGAGAAAATTCACGACATGATTGAAAGT
AAAAAACAACTAGCGGAACAGGTTGTTGGAGCAGGCGAAGAATGGTTAACTGAATTAGATACAGAT
CAACTCCGCAACTTACTGATACTTGATCGTAGTACAGTAATTGATGAAGAAGCAGATTGA

SEQ ID NO: 60, Nostoc sp. PCC7120 Nos_sp_PCC7120_SNF2 translated polypeptide

MAILHGSWILNEQESCLFIWGETWRSPQVDFNFAEISLNPLALSALELSEWLQSQHQAIAKLLPQQ
LEKRTSKAASSVKINLLTHSQIIALPTEISQPRKKETILISPVHSAALASESDSEVYLQTWRVEGF
CLPPSAAIKLLTSLPLNITSGENAFLGGDLRFWSQIARWSLDLISRSKFLPIIQRQPNNSVSAKWQ
VLLDSAVDGTRLEKFAAKMPLVCRTYQEIGSGESPIYIDFPSQPQDLILGFLNSAIDTQLREMVGN
QPVVETRLMASLPSAVRQWLQALIAASNSIDADAVGLERLEAALKAWTMPLQYQLASKNQFRTCFE
LRSPEPDETEWTLAYFLQAADDPEFLVDAATIWQNPVEQLIYQQRTIEEPQETFLRGLGLASRLYP
VIAPTLDTESPQFCHLKPMQAYEFIKAVAWRFEDSGLGVILPPSLANREGWANRLGLKISAETPKK
KPGRLGLQSLLNFQWHLAIGGQTISKAEFDRLVALKSPLVEINGEWVELRPQDIKTAEAFFTARKD
QMALSLEDALRLSSGDTQVIEKLPVVSFEASGALQELIGALTNNQAVAPLPTPKNFQGQLRPYQER
GAAWLAFLERWGLGACLADDMGLGKTIQFIAFLLHLKEQDVLEKPTLLVCPTSVLGNWEREVRKFA
PTLKVLQYHGDKRPKGKAFQEAVKKHDLVITSYSLIHRDIKSLQGIPWQIIVLDEAQNVKNAEAKQ
SQAVRQLETTFRIALTGTPVENRLQELWSILDFLNPGYLGNKQFFQRRFAMPIEKYGDAASLNQLR
ALVQPFILRRLKTDRDIIQDLPDKQEMTVFCGLTGEQAALYQKAVETSLAEIESAEGLQRRGMILA
LLIKLKQICNHPAQYLKINTLEQHSSGKLQRLEEMLEEVLAESNTYGVAGAGRALIFTQFAEWGKL
LKPHLEKQLGREIFFLYGGTSKKQREEMIDRFQHDPQGPPIMILSLKAGGVGLNLTRANHVFHFDR
WWNPAVENQATDRVFRIGQTRNVQVHKFVCNGTLEEKIHDMIESKKQLAEQVVGAGEEWLTELDTD
QLRNLLILDRSTVIDEEAD

SEQ ID NO: 61, Nostoc sp. PCC7120 Nos_sp_PCC7120_SNF2 II nucleic acid sequence

ATGAAAGTCCTTCATGGCTCGTGGATACCAAACCAATATAGCGATTTTGTGCAGTCTGGAGCATTT
TATCTATGGGTAGAAACTCCGATTAATAACAAAAAGCGTACTCATACACAAGTTCATCCCGGACAT
CTATCTTCTCTTGAATTACTCAATTTTCTGACTCAAACTTTGGGGATTAAAGAAACTGAAGCGCAA
TTAAAACAACGGATATGTTCTAAATATTTTGCCCTACCAACTGCTAATAATGAGCCATTACCTTCA
CCAGAGTTAGTCAAATATTTAGAAGTAGAAGTTCCTGAAGAGTATGAAAATTTTCAATATTGGCAG
GTAACTTGTTATGAAACTGTTACTTCTGTGAAAGCAGTGATAGCAATTAATATTATTAAATTACTC
AAAGATATTCATTTTTTAGCCCTGTACAATGCTAGTGAATTTCAATTAGGGTCAGATTTATTATTT
TGGTATCATTATACGCAATCATTTAGACAAATAATTACTAAGGATCAATATATTCCATCTTTAAAA
TATAGAGCGAACGCAGCGACTACAAAGAAAAAACCTAAACAACCACCCCCAGGATTTGAAATATAT
GCTGGTTGGGAAATAATTTCCGAGCAATACGAAGCCAATATTCAAAAATATATTGAATATATGCCA
TTGATTTGTGTAGCAGGTAACAGCACACAAACTGATAAATTAGAATTTTTTGCTCCAGAAACTCTA
TTACGCCACTTCAGCGAGTATCTGCTTAATAATTTAGTGAGTAAGACACCATTGACCGCAGCATTT
GAAAAACAAATTGATGATTCTTTAATTCACTATTGTCTTTATCCCCAAAAACACAACCCACTCAAA
ACCCATACTGCTCTCCAAGAGTATCAGCAGTGGTTGGGATGGAAAAACAGGATTATCCGTACTCAA
GCTGAATCACCATTTCATCTTTGCTTCCAATTACATTCACCTGATGCTGAACAAATTGACAATTGG
CAGATGCAATTTTTAGTATCAAGTAAAAAAGATCCGTCTCTAAAATTAGCTTTGGCAGATTACTGG
ATAATGAATTCCAAAACCAAAGCTGGTGTACATAAAGAGTTTGGCAAAGATTTCGATACTAATTTA
CTGCTGAATTTAGGCTATGCAGCAAGAATGTATCCCAAACTTTGGCAAGGTTTAGAAACGGACTCT
CCCACAGGAATGCAGCTAAGTTTAGATGAGGCGTTTGATTTTCTCAAAGATAGTGCTTGGGTGTTG
GAAGACTCAGGATTTAAGGTCATTGTCCCGGCTTGGTATACTCCGGCTGGTCGTCGTCGTGCGAAA
ATCCGCCTCAAAGCTTCTAGTGGTCGCAAGGTAGCTGCTACGGTAGGGGAAAGCAAAAGTTATTTC

FIGURE 10 (continued)

GGTTTAGATTCACTAGTGCAGTATCAGTATGAATTAGCAATTGGAGAGCAAACTCTCACACCTCAA
GAATGGGAACAATTGATTAATACTAAAGCACCACTAGTGCATTTTCGCGGTCAATGGATGGAATTA
GACCGGGATAAAATGCAGCAGTTATTAGAATTTTGGCAGTCCCACGGCGATGAACAGCCCCAAATG
AGCTTGTTAGAGTTCATGCAACGCAGCGCCCAAGGGGAAGATGACTGGGAAATTGAATATGATGCA
GCTTTATCAGAAATAATGGCAAAGTTACAAGATAAGAGTCAGCTAGAGCCAATTTCTGAAGACTTA
AATTTGCAAGGCAACCTGCGAGAATATCAAAAGCGGGGTGTAGCCTGGTTACAATATTTAGAAAAA
TTGGGATTAAATGGCTGTTTAGCCGATGATATGGGACTGGGTAAGTCCGTGCAGGTAATTGCGAGA
TTAGTACAGGAGAAAGATAGCCAAAGTTCCCCATTACCGACATTATTAATTGCGCCGACTTCGGTT
GTTGGTAACTGGCAAAGAGAAATTGCTAAGTTTGCACCCCATTTAAAAACTATGGTGCATCATGGT
AGCGATCGCCTGCAAGATGCTGCGGAGTTTAAGTCCGCCTGTCAACAGCATGATGTGGTGATAAGT
TCCTTTACTTTGGCTCGCTTAGATGAAAAACTCCTAAATAGTGTGACATGGCAACGGTTAGTTTTA
GATGAAGCACAAAACATTAAAAATCCCAAAGCAGCGCAGACTAAAGCTATACTCAAACTCAGTGCT
AAACACCGTCTAGCTTTAACTGGTACACCAGTTGAGAACCGCTTACTTGATTTGTGGTCAATTTTT
AATTTTCTCAATCCCGGTTATTTAGGGAAAGAAGCACAGTTTCGCAAATCCTTTGAAATTCCCATC
CAGAAGGACAACGATAAAGTAAAATCGACTACCTTAAAGAAACTGGTTGAACCGTTAATTTTACGA
CGGGTCAAAACAGACCAATCAATTATTAAAGACTTACCAGATAAAGTTGAACAAAAACTCTATACC
AACCTCACCAAAGAACAGGCTTCGCTATATGAAGTGGTAGTCAGAGATGTGGAAGAAAAATTGCAA
GAAGCTGAGGGAATACAACGCAAAGGTTTAATTCTCTCAACGCTGATGAAATTAAAACAGATTTGC
AATCATCCCAGACAGTTCCTCCAAGATAATAGCGAATTTTTACCGGAGCGCTCGCACAAACTTTCC
CGCTTAGTCGAAATGGTAGATGAAGCCATTTCTGAAGGAGAAAGTCTTTTAATATTTAGTCAATTT
ACAGAAGTCTGCGAACAAATAGAAAAATATCTCAAACACAACTTACATTGCAATACCTACTACCTA
CATGGGGGTACAAGTCGCCAACGTCGGGAACAAATGATTAGTGACTTTCAAAATCCTGATACGGAA
GCATCTGTATTTGTCCTTTCCCTAAAAGCTGGCGGCGTGGGGATTACTTTAACTAAAGCCAACCAC
GTCTTTCATTTTGACCGTTGGTGGAATCCAGCCGTTGAAGACCAAGCCACAGACCGCGCTTTTCGC
ATAGGTCAGAAAAAAAATGTGTTTGTACATAAATTTGTCGCCCTTGGGACTTTAGAAGAAAGAATC
GACCAAATGATTGAAGATAAGAAAAAACTTTCTTCCGCCGTAGTTGGTAGTGATGAATCGTGGCTA
ACCGAATTAGATAACGAAGCCTTTAAGAAACTAATTGCCTTGAATAAAAGCACAATTATGGAGTAG

SEQ ID NO: 62, Nostoc sp. PCC7120 Nos_sp_PCC7120_SNF2 translated polypeptide\II

MKVLHGSWIPNQYSDFVQSGAFYLWVETPINNKKRTHTQVHPGHLSSLELLNFLTQTLGIKETEAQ
LKQRICSKYFALPTANNEPLPSPELVKYLEVEVPEEYENFQYWQVTCYETVTSVKAVIAINIIKLL
KDIHFLALYNASEFQLGSDLLFWYHYTQSFRQIITKDQYIPSLKYRANAATTKKKPKQPPPGFEIY
AGWEIISEQYEANIQKYIEYMPLICVAGNSTQTDKLEFFAPETLLRHFSEYLLNNLVSKTPLTAAF
EKQIDDSLIHYCLYPQKHNPLKTHTALQEYQQWLGWKNRIIRTQAESPFHLCFQLHSPDAEQIDNW
QMQFLVSSKKDPSLKLALADYWIMNSKTKAGVHKEFGKDFDTNLLLNLGYAARMYPKLWQGLETDS
PTGMQLSLDEAFDFLKDSAWVLEDSGFKVIVPAWYTPAGRRRAKIRLKASSGRKVAATVGESKSYF
GLDSLVQYQYELAIGEQTLTPQEWEQLINTKAPLVHFRGQWMELDRDKMQQLLEFWQSHGDEQPQM
SLLEFMQRSAQGEDDWEIEYDAALSEIMAKLQDKSQLEPISEDLNLQGNLREYQKRGVAWLQYLEK
LGLNGCLADDMGLGKSVQVIARLVQEKDSQSSPLPTLLIAPTSVVGNWQREIAKFAPHLKTMVHHG
SDRLQDAAEFKSACQQHDVVISSFTLARLDEKLLNSVTWQRLVLDEAQNIKNPKAAQTKAILKLSA
KHRLALTGTPVENRLLDLWSIFNFLNPGYLGKEAQFRKSFEIPIQKDNDKVKSTTLKKLVEPLILR
RVKTDQSIIKDLPDKVEQKLYTNLTKEQASLYEVVVRDVEEKLQEAEGIQRKGLILSTLMKLKQIC
NHPRQFLQDNSEFLPERSHKLSRLVEMVDEAISEGESLLIFSQFTEVCEQIEKYLKHNLHCNTYYL
HGGTSRQRREQMISDFQNPDTEASVFVLSLKAGGVGITLTKANHVFHFDRWWNPAVEDQATDRAFR
IGQKKNVFVHKFVALGTLEERIDQMIEDKKKLSSAVVGSDESWLTELDNEAFKKLIALNKSTIME

FIGURE 10 (continued)

SEQ ID NO: 63, Nostoc punctiforme PCC 73102 Nospu_PCC\73102_SNF2 nucleic acid sequence

ATGGCGATTTTACACAGTAATTGGTTACTAAAAAGTCAAAAAGGTTGTTTATTTATTTGGGGAGAA
ACTTGGCGATCGCCACGAGTTAATTTCGAGTCTAATGGATCTGGAGATATCCCACTAAATCCATTG
GCAATGACATCACTAGAGTTGAGCGAGTGGTTGGTTTCCCAGAAGATGGCCATTACCAACTTTATC
CAGCAACCCCAAATTGCCATCGCTACTACTGGGCGAACACGTAAAGCAGCCACTGCCACTGAGATA
AACTTACCAACGCATTCACAAATAATTGCCTTACCAACTTATATTCCCGAAGAGAGTGCAGAAGGA
ACATCTGCAATTTTCCCTGTGCATTCTGCCAGCTTGAGACTAGAAACAGACTCTCCGCAATATTTG
CAACCGTGGCTAGTTGAGGGTTTTTGTCTTAACCCCAGCGAAGCAGTAAAATTTCTCGCTGCTGTT
CCCCTGAATGCTGCTAAAGGGGAAGATGCTTTTTTAGGAGGAGATTTACGTTTTTGGTCGCAAGTT
TCCCGATGGAGTTTAGATTTAATCTCGCGGTGTAAGTTTTTACCAAGAATTGAACGGCAATCAGAC
GGTGCATTTGCTGCTAAATGGCAAGTACTTCTAGACAGTGCTGTAGATGGAACTCGCCTAGAAAAG
TTTTCTGCGGATATGCCGTTGGTTTGCCGCACTTATCAGGAGGGAGTGGGGACTGGGGACTGGGGA
CTGAGGACTGGGGAGGAGTTTTCCCAATCCCTAATCCCTAATTCCCAATCCCTACTTTATGTAAAC
TTCCCTACTGAACCTCAAGAATTGTTGCTGGGATTTCTCAACAGTACGATAGATGCCCAAGTGCGA
GGGATGGTGGGTTCTCAGCCTCCAATGGAAGCTAAGGCAATGGCATCTTTACCATCTGGGGTGCGG
CAGTGGTTGCAAGGCTTGACTAGTACATCTGGTACAGTTAACGCAGATGCCATTGAAGTGGAACGA
CTGGAAGCGGCACTGAAGGCTTGGATGATGCCGCTACAATACCAATTAACTCTTAAAACTCTATTT
CGTACCTGTTTTCAACTGCGTTCTCCAGAAGCTGGCGAAACAGATTGGACATTGGCGTATTTTCTG
CAAGCGGCTGACGATCCTGATTTTTTGGTGGATGCGGCAACTATTTGGAACAATCCAGTTGAACGT
TTGGTTTATGAAAATCGAACAATTGAGCAACCACAGGAAACATTTTTGCGAGGTTTAGGGGTAGCT
TCCCGATTATATCCAGCGATCGCACCCAGTTTTGAAACCGAATATCCCCAATCTTCTCGGATCACA
CCCATGCAAGCTTATGAGTTTATCAAGGCTGTAGCTTGGAGGTTGGAAGACAGTGGTTTGGGGGTA
ATTTTGCCTCCTAGTTTAGCGAACCGCGAAGGATGGGCAAATCGTTTGGGTTTGAAAATTACTGCT
GAAACCCCAAAGAAAAAGCAGGGACGTTTAGGGTTGCAAAGTCTGCTGAATTTCCAATGGCAATTG
GCAATTGGCGGACAGACTATTTCCAAAGCTGAGTTTGATAAACTTGTGGCTTTAAATAGTCCACTA
GTGGAAATTAACGGTGAGTGGGTAGAATTGCGGCCCCAAGATATCAAGACAGCCCAAACATTTTTT
ACCACTCGCAAAGACCAAATGGCGCTTTCCTTGGAAGATGCCTTGCGTTTCAGTACAGGAGATACC
CAGGTAATTGAAAAATTACCAGTGGTCAGCTTTGAGGCATCTGGGGCATTGCAAGAGTTGATTGGG
GCGCTAAATAATAATCAAGCGATCGCACCTTTACCGACACCAGTAGGCTTTAAAGGACAGTTGCGA
CCTTATCAAGAACGTGGTGCTGCTTGGCTGTCCTTCTTGGAACGTTGGGGCTTAGGCGCGTGTCTC
GCCGACGATATGGGACTCGGTAAAACTATTCAGTTTATTGCTTTTTTGCTACATCTTAAAGAACAG
GATGCACTAGAAAATTCAACACTGCTAGTTTGTCCAACTTCTGTTTTAGGCAACTGGGAAAGGGAA
GTCAATAAATTTGCACCAAGCCTGAAAATTTTGCAATATCACGGTGACAAACGTCCAAAAGGGAAA
GCGTTTTTAGAAGCAGTGAAAAATCACGATTTAATCGTTACCAGCTACTCACTGCTTCATCGGGAT
ATCAAGTCATTGCAAAGTGTTCCTTGGCAGATAATTGTTTTAGACGAAGCCCAGAATGTGAAAAAT
CCAGAGGCGAAGCAGTCAAAAGCTGTGCGGCAATTAGAAGCTACATTTCGCATTGCATTAACGGGG
ACACCAGTAGAAAATAGACTGCAAGAACTATGGTCTATTTTGGATTTTCTCAATCCAGGGTATTTA
GGTAATAAGCAATTTTTCCAGCGGCGGTTTGCCATGCCAATTGAAAAGTATGGTGATACGGCTTCT
TTGGGTCAATTACGTTCATTAGTTCAGCCATTTATACTGCGGCGATTAAAAAGCGATCGCGAAATT
ATTCAAGACTTGCCAGATAAGCAAGAGATGACCGTATTTTGCGGTTTAACTGCCGACCAAGCTGCA
CTTTATCAACAAGTTGTAGAACAATCTTTAGTAGAGATAGAATCTGCTGAAGGATTGCAACGTCGG
GGGATGATTTTGGCTTTGCTAATCAAACTGAAGCAAATCTGCAATCATCCAGCCCAATATTTGAAA
CAGGCGACATTAGAGCAACATAATTCAGCCAAACTTCTGCGGCTAGAAGAAATGTTAGAAGAAGTT
TTAGCAGAAAGTGACCGGGCTTTAATCTTTACACAATTTGCAGAGTGGGGTAAGTTACTTAAACCC
AAAAGTGTTGAATGTTAA

FIGURE 10 (continued)

SEQ ID NO: 64, Nostoc punctiforme PCC 73102 Nospu_PCC\73102_SNF2 translated polypeptide

MAILHSNWLLKSQKGCLFIWGETWRSPRVNFESNGSGDIPLNPLAMTSLELSEWLVSQKMAITNFI
QQPQIAIATTGRTRKAATATEINLPTHSQIIALPTYIPEESAEGTSAIFPVHSASLRLETDSPQYL
QPWLVEGFCLNPSEAVKFLAAVPLNAAKGEDAFLGGDLRFWSQVSRWSLDLISRCKFLPRIERQSD
GAFAAKWQVLLDSAVDGTRLEKFSADMPLVCRTYQEGVGTGDWGLRTGEEFSQSLIPNSQSLLYVN
FPTEPQELLLGFLNSTIDAQVRGMVGSQPPMEAKAMASLPSGVRQWLQGLTSTSGTVNADAIEVER
LEAALKAWMMPLQYQLTLKTLFRTCFQLRSPEAGETDWTLAYFLQAADDPDFLVDAATIWNNPVER
LVYENRTIEQPQETFLRGLGVASRLYPAIAPSFETEYPQSSRITPMQAYEFIKAVAWRLEDSGLGV
ILPPSLANREGWANRLGLKITAETPKKKQGRLGLQSLLNFQWQLAIGGQTISKAEFDKLVALNSPL
VEINGEWVELRPQDIKTAQTFFTTRKDQMALSLEDALRFSTGDTQVIEKLPVVSFEASGALQELIG
ALNNNQAIAPLPTPVGFKGQLRPYQERGAAWLSFLERWGLGACLADDMGLGKTIQFIAFLLHLKEQ
DALENSTLLVCPTSVLGNWEREVNKFAPSLKILQYHGDKRPKGKAFLEAVKNHDLIVTSYSLLHRD
IKSLQSVPWQIIVLDEAQNVKNPEAKQSKAVRQLEATFRIALTGTPVENRLQELWSILDFLNPGYL
GNKQFFQRRFAMPIEKYGDTASLGQLRSLVQPFILRRLKSDREIIQDLPDKQEMTVFCGLTADQAA
LYQQVVEQSLVEIESAEGLQRRGMILALLIKLKQICNHPAQYLKQATLEQHNSAKLLRLEEMLEEV
LAESDRALIFTQFAEWGKLLKPKSVEC

SEQ ID NO: 65, Pelodictyon phaeoclathratiforme BU-1 Pelph_BU-1_SNF2 nucleic acid sequence

ATGATTGCGCTGCACATCTCCATCATTGACGGAGTCCCGCTACTCTGGAGTGAGGGAAAAAAGATC
GGGATGCTGAAGGAGTTACGCCTCGCAACGGCTGGAATCGGCATGTTTTCCCTGCTCGACAACACC
ACAAAAGAGTTTTGTGTCTGGCTGCCCTGCCGCGAGAAAAAAGCTGTCCCATCATCTCCGCTTGTC
GGCGCCATGCCCGACCTGAGTGATGAAGAGCAACTCCATGCCTTTCCGATTACCGCGCTTCGGCTG
AATTTCAACGCTCTGTTCGAGCTTTCCCTGCTTACGGAAAAGGGCAACATCCCCGGCAGTGGCATC
ATCTTCGGAAGCTCTCTCCACTGGGCACGGCAGGTAGTAAAAATTGCACTGAACATTGTCAGAACC
CAGTCGCTGCTCCCTTCGATCATCAAAAACGATACATTCTGGGAGGCCTTGTGGTTGCCCCTCCCC
GACAGTGCCACATCCCTCGCAGTTGAACAGCTTGCCGATGCCATGCCTGCGGTCTGTCGCTCTCTC
GGCCGCACCGACACGCAACCGCCGGAAACACCAAAAAAGTTACTGCTCAAAGGACTTCTCTCTTTC
CTTGTCAATACACTGTCACGTACTTTTGAAAGAGCAGGGGTGCCAAAAATCAGTGACTTCGAGAGT
ATCCATGACGCGTGGCTTCATGCATTATCAAACAGTGATCCCCGGCTGAAATGGAAAAATGAGCAG
GAGATTGAGCAGTTTGCCTGTCAGCTCAACGCATGGCGGCGTCCCATTGACCTGCATGAGCGATCA
CCCTTCAGGTTTTGCCTGCAACTGACAGAGCCACCACTGAAAGGGCGGAAAAAGGAGCGCTGGCAT
GTTGCCTATCAACTGCAGTTGAAAGCGGATCCAAGCCTGATTCTTGACGCCGGGGATCTCTGGAAC
CCCGAAAGCGAGGCATCACAGCACGCTTTAACGTATACCTCCGATTGTACCGAATTCCTGCTTACT
TCCCTGGGACAAGCCTCCGGCCTCTGCCCCGCAGTCACCCAAAGCCTGAAAAAGAAGCAGCCGGGT
GGCTTTGATCTTGATACCGAAGGGGCTTACAGATTTTTGCTGGAGTATGCGGAACTGTTGCGAAGC
GCAGGATTTGTGGTCAAGCTTCCCTCGTGGTGGATCGGTCGCAGAGGAGTCAACCGTATCGGGATC
AAGACAAAAGTGAAGCTTCCCTCTATGAAAGGAAGCGGGTCGGGTCTCACGCTGGATCGCATGGTT
GCCTGCGATTATGCTGCTGCACTTGGCAATGAGGAGCTTGACCTGCAGGAGCTGAAAACACTGGCA
AACCTGAAAGTTCCGCTGGTACGGGTGCGCGGACAGTGGACACAGATTGACCATAAGGAGCTTGCC
AATGCTCTCCATTTTCTTGAAAAACATCCAACTGGTGAACTTTCTGCCAGAGAACTCCTCTCAACA
GCTCTCGGAGCACAAAAAAAGGAGGATGCTCTCTTTCTTCGATCGGTTGAAATCGAGGGGTGGCTT
CAGGAACTGCTTGAAAAACTTTCCTCTCAGGGACAATTTGAACTGCTTCCACCACCTGAGCATTTC
GAGGGAACGCTTCGCCTCTATCAGGAGCGAGGCTTTTCATGGCTCTCATTTCTCCGCAAGTGGGGA
CTGGGCGCCTGTCTTGCCGACGACATGGGCCTTGGCAAAACCATTCAGACGCTTGCACTGCTGCAG
CGGGAGCGTGAACTTGGAGAAAAAAGGGCGGTGCTCCTGATCTGCCCCACCTCTGTAGTCAACAAC
TGGCGAAAGGAGGCGGAGCGGTTCACTCCGGATTTAGCGGTGCTGGTGCATCATGGTATCGACCGG

FIGURE 10 (continued)

ATGAAAACAGCAGATTTTCGCAAAGCTGCAAGCGCTTCAGCCCTTGTCATTTCAAGCTATGGATTG
TTACAGCGCGACCTTGAATTTCTGTCGAAGGTTCCCTGGGCAGGCATTATTCTCGATGAAGCGCAG
AACATCAAAAACCCTGAGACAAAACAGTCAAAAGCTGCCCGAACAATCCGGGCTGATTACCGTATT
GCCCTGACCGGCACTCCCGTTGAAAATCATGTCGGCGACCTTTGGGCACTCATGGATTTTCTCAAT
CCCGGTTTTCTTGGAACCCAGCACTTTTTCAAACAGAACTTCTACACGCCGATTCAGTGGTATGGC
GACCCTGAGGCTTCAGCACGACTGAAGTCGCTGACCGGCCCGTTTATTCTGCGCCGCATGAAAAGC
GACAAGTCGATTATTTCCGATCTGCCCGACAAGATCGAAATGAAAGAGTATTGCTCGCTGACCAAA
GAGCAGGCATCGCTCTACAAGGCTGTTGTCGATGAACTGCAGGAGAAAATTGAAAGCGCCGAAGGG
ATTGACCGGCGGGGCCTTGTACTTGCGCTGCTGGTCAAGCTCAAGCAGGTCTGCAACCATCCGGCA
CATTTGCTTGGCGACAACTCTGCCATTGCACATCGTTCAGGAAAAATAAAACGCCTGACCGAACTG
CTTGGCGACATCCGCGAAGCTGGCGAAAAAACGCTGCTCTTTACACAGTTTACCATGATGGGAACG
ATGCTCCAGCACTATCTTCAGGAGTTGTACGGTGAAGAGGTACTGTTTCTGCACGGTGGCGTAACC
AAAAAAAGGCGGGATGAGATGGTAGAGAGCTTCCAGAAGGAAGAGGGCAGTTCACCCTCCATCTTT
ATTCTCTCACTGAAAGCCGGAGGAACGGGTCTTAACCTGACAACAGCGAACCACGTTGTTCACTTT
GACCGATGGTGGAACCCGGCAGTAGAGAATCAGGCAACTGACCGGGCTTTCCGTATCGGGCAGCAC
AAAAACGTTGAAGTTCATAAATTTATTACGACGGGCACGCTCGAAGAGCGCATTGATGAGATGATT
GAGAAAAAAACAACGGTCGCCGGCCAGGTTCTCGGAACGGGTGAGCAGTGGCTGACCGAACTGTCG
AACAATGATCTGCGCAAGCTCATTATGCTCGGACAGGAAGCAATGGGAGAATAA

SEQ ID NO: 66, Pelodictyon phaeoclathratiforme BU-1 Pelph_BU-1 SNF2 translated polypeptide

MIALHISIIDGVPLLWSEGKKIGMLKELRLATAGIGMFSLLDNTTKEFCVWLPCREKKAVPSSPLV
GAMPDLSDEEQLHAFPITALRLNFNALFELSLLTEKGNIPGSGIIFGSSLHWARQVVKIALNIVRT
QSLLPSIIKNDTFWEALWLPLPDSATSLAVEQLADAMPAVCRSLGRTDTQPPETPKKLLLKGLLSF
LVNTLSRTFERAGVPKISDFESIHDAWLHALSNSDPRLKWKNEQEIEQFACQLNAWRRPIDLHERS
PFRFCLQLTEPPLKGRKKERWHVAYQLQLKADPSLILDAGDLWNPESEASQHALTYTSDCTEFLLT
SLGQASGLCPAVTQSLKKKQPGGFDLDTEGAYRFLLEYAELLRSAGFVVKLPSWWIGRRGVNRIGI
KTKVKLPSMKGSGSGLTLDRMVACDYAAALGNEELDLQELKTLANLKVPLVRVRGQWTQIDHKELA
NALHFLEKHPTGELSARELLSTALGAQKKEDALFLRSVEIEGWLQELLEKLSSQGQFELLPPPEHF
EGTLRLYQERGFSWLSFLRKWGLGACLADDMGLGKTIQTLALLQRERELGEKRAVLLICPTSVVNN
WRKEAERFTPDLAVLVHHGIDRMKTADFRKAASASALVISSYGLLQRDLEFLSKVPWAGIILDEAQ
NIKNPETKQSKAARTIRADYRIALTGTPVENHVGDLWALMDFLNPGFLGTQHFFKQNFYTPIQWYG
DPEASARLKSLTGPFILRRMKSDKSIISDLPDKIEMKEYCSLTKEQASLYKAVVDELQEKIESAEG
IDRRGLVLALLVKLKQVCNHPAHLLGDNSAIAHRSGKIKRLTELLGDIREAGEKTLLFTQFTMMGT
MLQHYLQELYGEEVLFLHGGVTKKRRDEMVESFQKEEGSSPSIFILSLKAGGTGLNLTTANHVVHF
DRWWNPAVENQATDRAFRIGQHKNVEVHKFITTGTLEERIDEMIEKKTTVAGQVLGTGEQWLTELS
NNDLRKLIMLGQEAMGE

SEQ ID NO: 67, Prochlorococcus marinus str. CCMP1375 Proma CCMP1375 SNF2 nucleic acid sequence

ATGACTCTGCTGCACGCCACTTGGATTTCAACTAATTGGCATCCATCTAATTTAGGTCAATCAGAA
TTGTTCCTTTGGGCAGACCAATGGCGCGTAGTAACTCCAAAACAAATAATACAAACACCTTCACCT
CACCCGTTTAGCCTATCTTCAGATGAATTAAAAGAATGGCTCAATAGCAAAAAATTATTGCCTAAT
GAGAGTATTAATACATCTGCATGTCTCACTCTTCCTAGTAAACCCATTCACAAAAAAAATAACCAA
AAATCTAAGAATCAAAAAACTGGTATTGAATCTGAATGGAAGGGACTCCCTTTACAAGCTCATGAA
GAAATAGCAACACAATATGAATGTTGGCCATGGAAAGTAGATGGAATTTCACTCACTACTGTCGAA
GCAACAGAATGGCTTACAAAATTACCTTTATCAAAAAAAGATTCTGATCTTAGTGAAGAATTACTT
TGGTGGGCTCATTTAGAGCGTTGGTCTCTTAATCTAATTGCGAGTGGACTATGGCTACCTCAAGTT

FIGURE 10 (continued)

AAATTACACAAGAAAGAAGGAAATGAATATCGTGCATCATGGATACCTCTGCTGAATCAAGAAAAT
GAAAGAAATCGCTTAGAAGAGTTTGCAAAAAATATTCCCTTGGTCGCTATTTGTGCAGTCCCATGG
ATAGAAGCTAAAGGACAAATAGTCAATACTGAGCAAGTCTCAAATTCAAACAATAATACACTCTCT
TTATATAGGCCAAGACACAATCGCGTAGAAGTGATGGATCTTCTCGAAGAACTTATTGATGCACAA
CTTCGAAAAGATTTTCAACCAAGAACTAAAAACTTGGATCCATTGTTAAAAGCGTGGCAAGAAGCA
CTTGGCACGAAAGATGGAATAATTAACCTATCGAATGAAAACGCTAAAAGATTAGAAAAAGCAAGT
AAGAATTGGAAAAGAGGGTTGTCTAGTAATGTTCAACCTGCGAAAACATGTCTAGAGCTAATTGCA
CCGATTGATGATCTAGATTTATGGGACTTAAACTTTTCATTGCAATCAGAATCAGATCCGAGTATC
AGACTAGCTGCAGATCAAATTTGGGAAGCAGGCGTAGAAGTAACCAAAGTTGGCGGAATAACAATT
GACAACCCAAGTGAAATTCTTTTAGAAGGCCTAGGAAGAAGTCTTGAAATTTTCCCTCCAATTGAA
AAAGGACTAGAAAGCCCAACTCCTCACACAATGAAACTGTCTGCATCAGAAGCATTTGTACTTATT
AGAACAGCAGCAGCAAAACTTCGTGACATGGGTATTGGTGTAATACTGCCTAATAGTTTGTCCAAA
GGATTTGCAAGTCGACTTGGTCTTGCTATTCAAGCCGAATTACCAGAGTCTTCACTAGGCGTAATG
CTAGGAGAAAGTTTGAACTGGGATTGGGAGTTAATGATCGGAGGTATAAATTTAAGCATGAAAGAA
CTAGAAATGCTTGCAAAAAAAAATAGTCCTCTACTCAATCACAAAGGGACATGGATCGAATTACGT
CCTAATGATCTGAAAAATGCTTCAAAATTTTTTGCTAATACTCCAGAATTAAACCTCGATAAAGCA
TTAAGGCTTAGTGCTAATAAAGGCAACACTTTTATGAAACTTCCAGTACATCATTTTGAATCTGGA
CCAAGATTACAAAGTGTCTTAGAGCAATATCACCATCAGAAAGCGCCTGAACCTTTACCAGCACCT
AATGGATTCCATGGGCAATTAAGGCCTTACCAAGAAAGAGGTCTTGGGTGGCTTGCATTTCTTTAT
CGTTTTAAGCAAGGAGCATGCTTAGCAGATGACATGGGGCTTGGTAAAACTATTCAATTATTATGT
TTTATTCAGCACCTAAAAGTTCAAAACGAGCTTACTAAGCCTGTACTCCTAATTGCGCCTACATCT
GTGCTGACAAATTGGAAAAGAGAGGCTGCCACTTTTACTCCAGAACTATGTATACATGAACACTAT
GGTAGTAAGAGACATTCTTCAATACCAAAATTACAAAATTATCTAAAAAAAGTTGACATTATGATC
ACAAGTTATGGGTTACTTTATCGAGATGGCGAGCTGCTACAAGAAATCGACTGGCAAGGAATAGTT
ATTGATGAAGCTCAAGCTATTAAAAATTCCAAATCAAAGCAAAGTATTATAACTAGAGCAATAAGC
AAAAATCTCATAAGTAATCCCTTTAGAATTGCTTTAACAGGAACGCCAGTAGAAAATCGTATTAGT
GAACTATGGGCACTAATGGATTTCCTTAATCCAAAAGTATTAGGTGAAGAAGATTTTTTTAATCAG
CGATACAAGTTACCGATTGAGCATTATGGCGACATCTCTTCATTAAAAGATCTCAAAACACAGGTC
AGTCCTTTTATTTTAAGAAGATTGAAAACCGATCAATCTATTATTTCTGATTTGCCTCAAAAGATT
GAATTAAATGAGTGGGTTGGACTAAGCCAAGAGCAAGAGCTTCTATATAAACAAACGGTAGAGAAA
AGCTTAGATGAACTCGCCTCATTACCCATTGGTCAACGCCAGGGTAAAACATTGGGTCTACTTACT
CGTCTTAAACAAATTTGTAATCATCCAGCAATTGCTTTAAAAGAAACTCAAGTCGAGAAGAATTTC
TTATTAAGATCTTCAAAATTACAAAGACTGGAAGAAATACTACAAGAAGTGAAAGAATCTCATGAT
AGAGCTCTGCTCTTTACTCAATTTGCTGAATGGGGGCATTTATTGCAAGCGTACTTACAAACAAAA
TGGGAATCAGAAGTACCTTTCCTACACGGAGGCACTCCTAAAGGGAAGCGACAAGAAATGATAGAT
CGTTTTCAAGATGATCCTAGAGGGCCAAATATCTTTTTACTTTCACTAAAAGCAGGAGGAGTGGGT
CTTAATCTAACTCGTGCGAATCATGTTTTTCATATTGATCGTTGGTGGAATCCAGCAGTAGAAAAT
CAAGCAACAGATCGTGCATACCGAATTGGTCAAAAAAAAAGTGTTATCGTCCATAAGTTTATAACC
ACCGGCACAATCGAAGAAAAAATCAATCAAATGATTCTCGAAAAGACTGAACTAGCAGAAAATATT
GTCGGATCAGGAGAAAGCTGGTTAGGGCAATTAAGTCTTGAAAAATTGAGTGAATTAGTTGCTTTA
GATAGCAATCCAGAATTCTAA

SEQ ID NO: 68, Prochlorococcus marinus str. CCMP1375 Proma CCMP1375 SNF2 translated polypeptide

MTLLHATWISTNWHPSNLGQSELFLWADQWRVVTPKQIIQTPSPHPFSLSSDELKEWLNSKKLLPN
ESINTSACLTLPSKPIHKKNNQKSKNQKTGIESEWKGLPLQAHEEIATQYECWPWKVDGISLTTVE
ATEWLTKLPLSKKDSDLSEELLWWAHLERWSLNLIASGLWLPQVKLHKKEGNEYRASWIPLLNQEN
ERNRLEEFAKNIPLVAICAVPWIEAKGQIVNTEQVSNSNNNTLSLYRPRHNRVEVMDLLEELIDAQ

FIGURE 10 (continued)

LRKDFQPRTKNLDPLLKAWQEALGTKDGIINLSNENAKRLEKASKNWKRGLSSNVQPAKTCLELIA
PIDDLDLWDLNFSLQSESDPSIRLAADQIWEAGVEVTKVGGITIDNPSEILLEGLGRSLEIFPPIE
KGLESPTPHTMKLSASEAFVLIRTAAAKLRDMGIGVILPNSLSKGFASRLGLAIQAELPESSLGVM
LGESLNWDWELMIGGINLSMKELEMLAKKNSPLLNHKGTWIELRPNDLKNASKFFANTPELNLDKA
LRLSANKGNTFMKLPVHHFESGPRLQSVLEQYHHQKAPEPLPAPNGFHGQLRPYQERGLGWLAFLY
RFKQGACLADDMGLGKTIQLLCFIQHLKVQNELTKPVLLIAPTSVLTNWKREAATFTPELCIHEHY
GSKRHSSIPKLQNYLKKVDIMITSYGLLYRDGELLQEIDWQGIVIDEAQAIKNSKSKQSIITRAIS
KNLISNPFRIALTGTPVENRISELWALMDFLNPKVLGEEDFFNQRYKLPIEHYGDISSLKDLKTQV
SPFILRRLKTDQSIISDLPQKIELNEWVGLSQEQELLYKQTVEKSLDELASLPIGQRQGKTLGLLT
RLKQICNHPAIALKETQVEKNFLLRSSKLQRLEEILQEVKESHDRALLFTQFAEWGHLLQAYLQTK
WESEVPFLHGGTPKGKRQEMIDRFQDDPRGPNIFLLSLKAGGVGLNLTRANHVFHIDRWWNPAVEN
QATDRAYRIGQKKSVIVHKFITTGTIEEKINQMILEKTELAENIVGSGESWLGQLSLEKLSELVAL
DSNPEF

SEQ ID NO: 69, Prochlorococcus marinus str. MIT 9211 Proma MIT 9211 SNF2 nucleic acid sequence

ATGAGTCTGCTACACGCTACTTGGCTGCCAGCAATGCGAACCGGAAGTTCGCATAATCCAGGACTA
CTCATCTGGGCTGATTCATGGAGAGTTGCAAAACCAAGCATAGTCAGCAATCAGCCTGTAATACAT
CCATTTGCCTTATCAGCAGCAGATTTACGTATTTGGCTATTGCAAAAAAAGCTTTTACCTAAAGAA
AGTATTGAATGTACAGCCTTATTAACTCTACCTAGTAAATCTATTAAAAACTCATTAGACAAAAAA
TTAAATGGAGTAACGGACTCACAAAATACTAGCGATCAACCTCAATGGAGTGGACTACCTTTACAA
GCAGGAGAGCCAGTAACTAAACAATGTGAATGGTGGCCCTGGCAAGTTGAAGGTATAGCAATCAAA
CCCAGTGAAGCTGCATCGTGGCTTGCAAACTTACCTCTCACGAAAAAAGATCCTGAGCTTAGTGAA
GAGATCCTATGGTGGAGTCATTTAGAACGTTGGTCTCTAAGTTTAATTGCTCGTGGCCTTTGGTTG
CCACAAGTTGAATTAAATACAATTGATAATATTGGAGCTAGAGCTAGGTGGAGTCCTTTACTTAAT
AACGAAAACGAGCGCAAAAGATTAGAAGAATTCTCTATCAGGCTTCCATTAGTAGCAACATGTGCC
ATAAAAAGAGAGGAAACTTCTGAAGAAAATCAAAACCATATATTAAAGACTACTCCTAGGGAAACA
CTCGATGAATACGGACTTGCAGTATGTCGACCAATCAATAGTCGACTTCAAGTGGCTTATCTCTTA
GAAGAACTCGTGGATGGACAGCTAAGAAAAGATTTTGAGGAAAGTTCTGAAGACCTTGATCCATTG
CTGAAAGCTTGGCAAGAGGCATTAGGATCACATAATGGAGTCATTCGTCTTCCGTTGGAAGATTGT
GAAAGATTAGCCAAGGCAAGTAAAAATTGGAAAGAAAATTTATCAGGCAATGTTAAAGGTGCAAGA
GCATGCCTTGAGCTTTTTGCACCACTTGAAGGAGAAGATTTATGGGACTTACAATTCTCTTTACAA
GCTGAAGCAGATCCATCACTAAAGGTAGCAGCAGAAGCAGTATGGAATGCAGACTCAGCAGTTCTA
CAGATTGGTGATATTCAAATAGCGCAGCCTGGAGAAATTCTACTAGAAGGTCTTGGCAGAGCACTC
AATATCTTTCAACCAATAGAAAGGGGTCTGGAAAATGCTACTCCAAATAATATGCAACTCACACCT
GCAGAAGCTTTTGTTCTAGTACGTACAGCCTCAAAGCAATTACGTGATATTGGTATTGGTGTAATA
CTACCTAGAAGTTTATCAGGAGGATTAGCAAGTCGACTAGGTATAGCTATTAAAGCAGAGTTAGCG
ACTAGTGCCAGAGGATTAACACTTCGAGAGAATCTAGAATGGAGTTGGGAGCTAATGATAGGGGGA
AGCATATTAAGCCTTAAAGATCTAGAACAACTGGCAAGTAAACGCAGCCCTCTAGTTCGCTATAAG
GATTCATGGCTTGAATTACGTCCAAATGATCTTAAAATCGCCGAAAAATTCTGTAGCAATAATCCT
GAATTAAGCCTAGATGACGCATTAAGACTTACCGCAACTAAAGGGGAGACTCTAATGAAGCTTCCA
GTACATCAATTTAATGCTGGGCCAAAGCTCCAAGGCGTTTTAGAGCAATACCACCAACATACAAGT
CCTGAGCCTCTAGCTGCACCAGATGGCTTCTATGGACAACTGAGGCCTTATCAAGAACGTGGCATA
GGATGGTTGGCTTTCTTGCATCGTTTTAATCAAGGTGCATGTTTAGCAGATGACATGGGCCTGGGC
AAAACAATTCAAGTGCTTGCTTTTATTCAGCACTTAAAAAGTAACAAGGACCTCAAGAAACCTGTT
TTGCTAATTGCACCTACGTCAGTATTAACAAACTGGAAACGAGAAGCTTATTCATTTACACCAGAG
TTATCTGTATTAGAGCATTACGGTCCTAATCGTTCATCTACATCAACACTCTTGAAAAAGATTCTC
AAAAAAGTAGACATTCTTATTACTAGCTATGGCCTACTACATAGAGATAAACAGCTTCTGAAAACA

FIGURE 10 (continued)

ATTGATTGGCAAGGTGTAATTATTGATGAAGCACAAGCTATAAAAAATCCAAATTCAAAACAAAGT
CAAACAACTCGTGAAATTGTTAAAGGCGGAAAAATAATCCCTTTTCGTATTGCATTAACTGGTACC
CCTATAGAAAATCGTGTAAGTGAGCTTTGGTCATTAATGGATTTTTTAAATCCATCAGTACTTGGA
GAAAAAGAATTTTTTGATCAACGCTACAAATTACCGATTGAACGTTATGGTGATATTTCTTCGTTA
ACCGATCTCAAAGCTCGTGTCAGTCCCTTTATTCTTAGAAGGTTAAAAAGTGATAAATCAATTATC
TCGGATCTACCAAGCAAAGTCGAACTAAAAGAATGGATTACTCTTAGTCAAGAGCAAAGAGCTCTT
TATAACAAAACTGTAGACAATACCTTACAGGAAATCGCAAGAAGTCCTATTGGTCAGCGTCATGCG
AAAACCTTAGGTCTATTAACACGTCTCAAACAAATATGTAATCATCCTGCTCTTGCCCTCAAAGAA
AAAAACATTAGCGATGATTTTGGAATACGATCAACCAAACTTCAAAGGCTGGAAGAACTTCTTGAT
GTGATATTCGCAACAGAGGACAGAGCTCTTCTTTTTACCCAATTCGCTGAATGGGGTCACTTACTA
CAAGCTTATCTAGAAAAAAAGTGGGGACATAGCATACTTTTTCTACATGGAGGAACTCGCAAAATA
GATAGACAATCAATGGTTGATCAATTTCAAGAAGATCCCAGAGGCCCAAAATTATTTTTACTTTCT
CTCAAAGCAGGTGGTATTGGTCTGAACCTGACTCGAGCTAACCACGTGTTGCATATTGATCGATGG
TGGAACCCTGCCGTAGAAAATCAGGCAACAGATCGTGCTTATAGAATTGGTCAAAAAAATAGCGTA
ATGGTTCACAAATTTATTGCTACAGGGTCAGTAGAAGAAAAAATTGATCAAATGATTACTGAAAAG
TCTAAGCTCGCAGAAAATATAATTGGTGCAGGTGAAGATTGGCTTGGCAAACTTGGCATCAATGAA
TTACGTGAATTAGTTTCCTTAGAAAAAGAGAGTTAA

SEQ ID NO: 70, Prochlorococcus marinus str. MIT 9211 Proma MIT 9211 SNF2 translated polypeptide

MSLLHATWLPAMRTGSSHNPGLLIWADSWRVAKPSIVSNQPVIHPFALSAADLRIWLLQKKLLPKE
SIECTALLTLPSKSIKNSLDKKLNGVTDSQNTSDQPQWSGLPLQAGEPVTKQCEWWPWQVEGIAIK
PSEAASWLANLPLTKKDPELSEEILWWSHLERWSLSLIARGLWLPQVELNTIDNIGARARWSPLLN
NENERKRLEEFSIRLPLVATCAIKREETSEENQNHILKTTPRETLDEYGLAVCRPINSRLQVAYLL
EELVDGQLRKDFEESSEDLDPLLKAWQEALGSHNGVIRLPLEDCERLAKASKNWKENLSGNVKGAR
ACLELFAPLEGEDLWDLQFSLQAEADPSLKVAAEAVWNADSAVLQIGDIQIAQPGEILLEGLGRAL
NIFQPIERGLENATPNNMQLTPAEAFVLVRTASKQLRDIGIGVILPRSLSGGLASRLGIAIKAELA
TSARGLTLRENLEWSWELMIGGSILSLKDLEQLASKRSPLVRYKDSWLELRPNDLKIAEKFCSNNP
ELSLDDALRLTATKGETLMKLPVHQFNAGPKLQGVLEQYHQHTSPEPLAAPDGFYGQLRPYQERGI
GWLAFLHRFNQGACLADDMGLGKTIQVLAFIQHLKSNKDLKKPVLLIAPTSVLTNWKREAYSFTPE
LSVLEHYGPNRSSTSTLLKKILKKVDILITSYGLLHRDKQLLKTIDWQGVIIDEAQAIKNPNSKQS
QTTREIVKGGKIIPFRIALTGTPIENRVSELWSLMDFLNPSVLGEKEFFDQRYKLPIERYGDISSL
TDLKARVSPFILRRLKSDKSIISDLPSKVELKEWITLSQEQRALYNKTVDNTLQEIARSPIGQRHA
KTLGLLTRLKQICNHPALALKEKNISDDFGIRSTKLQRLEELLDVIFATEDRALLFTQFAEWGHLL
QAYLEKKWGHSILFLHGGTRKIDRQSMVDQFQEDPRGPKLFLLSLKAGGIGLNLTRANHVLHIDRW
WNPAVENQATDRAYRIGQKNSVMVHKFIATGSVEEKIDQMITEKSKLAENIIGAGEDWLGKLGINE
LRELVSLEKES

SEQ ID NO: 71, Prochlorococcus marinus str. MIT 9303 Proma MIT 9303 SNF2 nucleic acid sequence

ATGATTGGTTGTGGAACTCCTGCGTGGATGGTTGCCGTTGATCGGCAGTGCACTCCTGCTCCAAGA
AACCCAACACATACTTTTTGCGTCGCGGCCATGAGCCTGCTGCACGCCACCTGGCTTCCAGCCATC
CGTACTCCGACCAGCTCCGGTCGCCCTGCGCTCCTTGTGTGGGCAGATACCTGGCGAGTCGCTACC
CCAGCAGGACCAGCAGCAACTCCCGCACTCCACCCCTTCACACTCAACCCAGACGATCTACGTGCC
TGGCTGATTGAGCGCGATCTACTGCCCGATGAAATCATCGACGCCACAGCATGTCTGACCCTGCCT
AGCCGAACAGTCAAACCGCGCAGCAAAGCCAAGAACGTATCCACTGAATCCGACGAAGACAAAGAC
CACAAAACAAGTTGGACAGGACTGCCCTTACAAGCAGGCGAACCCATTCCCAAACAGACTGAATGG
TGGCCCTGGCAGGTGCAAGGCCTGGCAGTGGAGCCTGCTGCTGCAACGGCCTGGCTTTCGAAACTG

FIGURE 10 (continued)

CCTCTTTCAGGAGATCATCCTGATCTCGCCGATGAATTGCGCTGGTGGAGCCATCTACAGCGCTGG
GCCCTGAGCATGATTGCTCGCGGACGTTGGCTACCCCAGGTGGAACTCAGCAAGGGAGAGGGCTAT
CCCCACCGAGCACGCTGGACACCGCTACTCAACCGTGAAGATGATCGCCGCCGCCTCGAAGACCTT
GCCGCTCAGCTCCCCTTAGTGGCCACCTGCGCCCTCCCCTGGCGGGAGCCCACCGGAAGGCGTAGC
AACCGAATGACCCGCCTAAGACCAGAGGCGATGCGAGCCGCTAACCCTGTGGCTTCATGCCGACCC
CGCAGCGGTCGCCTTCGCGTAGCCAGCCTGCTGGAAGAACTCTTGGATGCCCAACTGCGCACCGGA
TTTGAAGCGAGTGAGCAAGGCCTAGACCCATTGCTCACAGCCTGGCAGGAAGCACTGGGGTCGGAC
AGCGGCGTGATCAACCTCCCCGATGAGGAAGCCGAACGTCTAGCGACAGCAAGCAACCATTGGCGA
GAAGGCGTGGCTGGCAACGTCGCACCAGCCAGGGCCTGCTTAGAACTCTTCACTCCCGGCGAAGGG
GAAGACCTCTGGGAGCTGCGCTTCGCCTTACAGGCTGAGGCTGATCCCACGATCAAAGTACCGGCC
GCAGCAGCCTGGGCAGCGGGTCCCAAGGTCCTGCAACTAGGCGAAATCCGTGTGGAACATCCAGGC
GAGGTGCTACTGGAAGGCATGGGGCGAGCCCTCACGGTGTTTGCACCGATCGAACGAGGCCTCGAC
AGCGCCACACCAGAAGCAATGCAGCTCACCCCTGCTGAAGCCTTTGTATTGGTGCGCACTGCAGCG
GCCCAACTGCGTGATGTTGGCGTTGGCGTGGAATTGCCTGCCAGCCTCTCGGGAGGGCTGGCCAGT
CGCCTAGGCCTAGCGATCAAGGCGGAGCTATCGGAGAGATCTAGAGGTTTCACTTTGGGCGAAACC
CTCGACTGGAGTTGGGAGCTCATGATCGGTGGCGTCACCCTGACGCTTCGCGAGCTGGAGCGACTA
GCAAGCAAGCGCAGCCCGCTTGTCAACCACAAGGGCGCCTGGATCGAATTACGCCCCAACGATCTC
AAAAATGCGGAACACTTCTGCAGCGTCAATCCAGGCATCAGCCTCGACGATGCCTTGCGCCTTACC
GCAACCGATGGCGACACGCTGATGAGACTGCCCGTTCACCGCTTTGAGGCCGGTCCACGACTACAG
GCGGTGTTGGAGCAGTACCACCAGCAAAAAGCTCCCGACCCCCTACCTGCTCCCGAAGGCTTCTGC
GGTCAGCTAAGGCCTTATCAGGAAAGGGGTCTGGGTTGGCTGGCCTTCCTGCATCGCTTCGATCAA
GGGGCATGCCTGGCCGACGACATGGGCCTGGGCAAAACGATCCAGCTACTGGCATTCCTGCAACAT
CTCAAGGCGGAACAGGAACTCAAACGGCCGGTATTGCTTATCGCTCCCACATCCGTACTTACCAAC
TGGAAGAGAGAGGCATTGGCCTTCACACCAGAGTTAAACGTCCGAGAACACTATGGGCCGCGTCGG
CCCTCTACCCCCGCCGCCTTAAAGAAAGCACTCAAAGGCTTAGACCTCGTTCTCACCAGTTACGGG
CTCCTGCAGCGAGATAGTGAGCTCCTGGAAACGGTCGACTGGCAAGGAGTGGTCATCGATGAAGCC
CAAGCCATTAAGAACCCCAACGCCAAACAGAGCCAAGCAGCACGCGATATGGGCCGCCCAGACAAA
AACAATCGCTTCAGGATTGCTCTTACCGGCACACCCGTCGAAAACCGAGTCAGTGAACTTTGGGCA
CTGATGGACTTCCTCAACCCAAGGGTTCTCGGTGAAGAAGACTTCTTCCGCCAGCGCTACCGGCTG
CCAATTGAACGCTATGGCGACATGTCTTCCCTGCGAGACCTCAAAGGCCGTGTTGGTCCCTTCATC
CTGAGACGACTAAAAACCGACAAGGCAATCATCTCCGACCTACCTGAAAAGGTAGAGCTGAGCGAA
TGGGTGGGTCTGAGCAAAGAACAGGCAGCCCTCTATCGCAACACAGTGGATGAAACACTGGAGGCC
ATTGCCCGCGCACCCAGTGGTCAACGTCATGGCAAGGTGCTCGGCTTGCTTACCCGACTGAAGCAA
ATCTGCAACCATCCCGCCCTAGCCCTCAAAGAAAAAACCGTTGCAAAAGGCTTCATGGACCGCTCC
GCCAAGCTGCTGCGTTTGGAAGAAATTCTCGAGGAAGTGATCGAGGCAGGAGATCGCGCTCTGTTA
TTCACCCAATTCGCAGAATGGGGTCATCTCCTTAAGGCCTACCTGCAACAACGCTGGCGCTTTGAA
GTTCCCTTCCTGCACGGCAGCACAAGCAAAACTGAACGTCAGGCCATGGTTGATCGCTTCCAGGAG
GATCCACGTGGACCCCAACTGTTCCTGCTGTCACTCAAAGCCGGTGGCGTAGGCCTAAACCTCACG
CGGGCTAGCCATGTGTTTCATGTCGATCGCTGGTGGAATCCTGCCGTAGAAAACCAGGCCACTGAT
CGCGCTTACAGGATCGGACAAACCAATCGGGTGATGGTGCACAAATTCATCACCAGCGGCTCAGTT
GAAGAGAAAATTGATCGCATGATTCGCGAAAAATCTCGACTTGCCGAAGACATCATTGGCTCTGGA
GAAGACTGGTTAGGTGGCTTAGGCGTCAGTCAATTGCGCGAACTAGTGGCCCTAGAAGACAGCTGA

SEQ ID NO: 72 Prochlorococcus marinus str. MIT 9303 Proma MIT 9303 SNF2 translated polypeptide

MIGCGTPAWMVAVDRQCTPAPRNPTHTFCVAAMSLLHATWLPAIRTPTSSGRPALLVWADTWRVAT
PAGPAATPALHPFTLNPDDLRAWLIERDLLPDEIIDATACLTLPSRTVKPRSKAKNVSTESDEDKD
HKTSWTGLPLQAGEPIPKQTEWWPWQVQGLAVEPAAATAWLSKLPLSGDHPDLADELRWWSHLQRW

FIGURE 10 (continued)

ALSMIARGRWLPQVELSKGEGYPHRARWTPLLNREDDRRRLEDLAAQLPLVATCALPWREPTGRRS
NRMTRLRPEAMRAANPVASCRPRSGRLRVASLLEELLDAQLRTGFEASEQGLDPLLTAWQEALGSD
SGVINLPDEEAERLATASNHWREGVAGNVAPARACLELFTPGEGEDLWELRFALQAEADPTIKVPA
AAAWAAGPKVLQLGEIRVEHPGEVLLEGMGRALTVFAPIERGLDSATPEAMQLTPAEAFVLVRTAA
AQLRDVGVGVELPASLSGGLASRLGLAIKAELSERSRGFTLGETLDWSWELMIGGVTLTLRELERL
ASKRSPLVNHKGAWIELRPNDLKNAEHFCSVNPGISLDDALRLTATDGDTLMRLPVHRFEAGPRLQ
AVLEQYHQQKAPDPLPAPEGFCGQLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQH
LKAEQELKRPVLLIAPTSVLTNWKREALAFTPELNVREHYGPRRPSTPAALKKALKGLDLVLTSYG
LLQRDSELLETVDWQGVVIDEAQAIKNPNAKQSQAARDMGRPDKNNRFRIALTGTPVENRVSELWA
LMDFLNPRVLGEEDFFRQRYRLPIERYGDMSSLRDLKGRVGPFILRRLKTDKAIISDLPEKVELSE
WVGLSKEQAALYRNTVDETLEAIARAPSGQRHGKVLGLLTRLKQICNHPALALKEKTVAKGFMDRS
AKLLRLEEILEEVIEAGDRALLFTQFAEWGHLLKAYLQQRWRFEVPFLHGSTSKTERQAMVDRFQE
DPRGPQLFLLSLKAGGVGLNLTRASHVFHVDRWWNPAVENQATDRAYRIGQTNRVMVHKFITSGSV
EEKIDRMIREKSRLAEDIIGSGEDWLGGLGVSQLRELVALEDS

SEQ ID NO: 73, Prochlorococcus marinus str. MIT 9313 Proma MIT 9313 SNF2 nucleic acid sequence

ATGATTGGTTGTGGAACTCCTGCGTGGATGGTTGCCGTTGATCGGCAGTGCACTCCTGCTCCAAGA
AACCCAACACATACTTTTTGCGTCGCGGCCATGAGCCTGCTGCACGCCACCTGGCTTCCAGCCATC
CGTACTCCGACCAGCTCCGGTCGCCCTGCGCTCCTTGTGTGGGCAGATACCTGGCGAGTCGCTACC
CCAGCAGGACCAGCAGCAACTCCCGCACTCCACCCCTTCACCCTCAGCCCAGACGATCTACGTGCC
TGGCTCATTGAGCGCGATCTACTGCCTGATGAAATCATCGACGCCACAGCATGTCTGACCCTGCCT
AGCCGAACAGTCAAACCGCGCAACAAAACCAAGAACGTATCCACTGAATCCGACGAAGCCAAAGAC
AACAAAACAAGTTGGACAGGACTGCCCTTACAAGCAGGCGAACCCATTCCCAAACAAACAGAATGG
TGGCCCTGGCAGGTGCAAGGCCTGGCAGTGGAACCTGCTGCCGCAACGGCCTGGCTTTCGAAACTG
CCTCTTTCAGGAAATCATCCTGATCTGGCCGATGAATTGCGCTGGTGGAGCCATCTACAGCGCTGG
GCCCTGAGCATGATTGCTCGCGGACGTTGGCTACCCCAGGTGGAACTCAGCAAGGGAGAGGGCTAT
CCCCACCGAGCACGCTGGACACCGCTACTCAACCGTGAAGATGATCGCCGCCGCCTCGAAGACCTT
GCCGCTCAGCTTCCCTTAGTGGCCACCTGCGCCCTCCCCTGGCGGGAGCCCACCGGAAGGCGTAGC
AACCGAATGACCCGCCTAAGACCAGAGGCGATGCGAGCCGCTAACCCTGTGGCTTCATGCCGACCC
CGCAGCGGTCGCCTTCGCGTAGCCAGCTTGCTGGAAGAACTCTTGGATGCCCAACTGCGCACCGGA
TTTGAAGCGAGTGAGCAAGGCCTAGACCCATTGCTCACAGCCTGGCAGGAAGCACTGGGGTCCGAC
AGCGGCGTGATCAACCTCCCCGATGAGGAAGCCGAACGTCTAGCTACAGCAAGCAACCATTGGCGT
GAAGGCGTGGCTGGCAACGTCGCACCAGCCAGAGCCTGCTTAGAACTCTTCACTCCCGGAGAAGGG
GAAGACCTCTGGGAGCTGCGCTTCTCCTTACAGGCTGAGGCTGATCCCACAATCAAAGTACCGGCC
GCAGCAGCCTGGGCAGCTGGTCCCAAGGTGTTGCAACTAGGCGAAATCCGTGTGGAACATCCAGGC
GAGGTGCTACTGGAAGGCATGGGGCGAGCCCTCACGGTGTTTGCACCGATCGAACGAGGCCTCGAC
AGCGCCACACCAGAAGCAATGCAGCTCACCCCTGCTGAAGCCTTTGTATTGGTGCGCACTGCAGCG
ACCCAACTGCGTGATGTTGGCGTTGGCGTGGAATTGCCTGCCAGCCTCTCGGGAGGGCTGGCCAGT
CGCCTAGGCCTAGCGATCAAGGCGGAGCTATCGGAGAGATCTAGAGGTTTCACTCTGGGCGAAACC
CTCGACTGGAGTTGGGAGCTCATGATCGGTGGCGTCACCCTGACGCTTCGCGAACTGGAGCGACTA
GCAAGCAAGCGCAGCCCGCTTGTCAACCACAAGGGCGCCTGGATCGAATTACGCCCCAACGATCTC
AAACATGCGGAACACTTCTGCAGCGTCAATCCAGGCATCAGCCTCGACGATGCCTTGCGCCTTACC
GCAACAGATGGCGACACGCTGATGAGACTGCCCGTTCACCGCTTTGAGGCCGGTCCACGACTACAG
GCGGTGTTGGAGCAGTACCACCAGCAAAAAGCACCAGACCCCCTACCTGCTCCCGAAGGCTTCTGC
GGTCAGCTAAGGCCTTATCAGGAAAGGGGTCTGGGTTGGCTGGCCTTCCTGCATCGCTTCGATCAA
GGGGCATGCCTGGCCGACGACATGGGCCTTGGCAAAACGATCCAGCTACTGGCATTCCTGCAACAT
CTCAAGGCGGAACAGGAACTCAAACGGCCGGTATTGCTTATCGCTCCCACGTCCGTACTCACCAAC

FIGURE 10 (continued)

TGGAAGAGAGAGGCGTTGGCCTTCACACCAGAGTTAAACGTCCGCGAACACTATGGGCCGCGTCGG
CCCTCTACCCCCGCCGCCTTAAAGAAAGCACTCAAAGGCTTAGACCTCGTTCTCACCAGTTATGGG
CTCCTGCAGCGAGATAGTGAGCTCCTGGAAACGGTCGACTGGCAAGGCGTGGTCATCGATGAAGCC
CAAGCCATTAAGAACCCCAACGCCAAACAGAGCCAAGCAGCACGCGATATGGGCCGCCCAGACAAA
AACAATCGCTTCAGGATTGCTCTTACCGGCACACCCGTCGAAAACCGAGTAAGTGAACTTTGGGCA
CTAATGGACTTCCTTAACCCAAGGGTTCTCGGTGAAGAAGACTTCTTCCGCCAGCGCTACCGGCTG
CCGATTGAGCGCTATGGCGACATGTCTTCCCTGCGAGACCTCAAGGGCCGTGTTGGTCCCTTCATC
CTGAGACGACTCAAAACCGACAAGGCAATCATCTCCGACCTACCCGAAAAAGTAGAGCTGAGCGAA
TGGGTGGGGCTGAGCAAAGAACAGGCAGCCCTCTATCGCAACACAGTGGATGAAACACTGGAGGCC
ATTGCCCGCGCACCCAGGGGTCAACGCCATGGCAAGGTGCTCGGATTGCTTACCAGACTGAAGCAA
ATCTGCAACCATCCCGCCCTAGCCCTCAAAGAACAAACCGTTGCAAAAGGGTTCATGGACCGCTCC
GCCAAGCTGCTGCGTTTGGAAGAAATTCTCGAAGAAGTAATCGAGGCAGGAGATCGCGCTCTGTTA
TTCACCCAATTCGCAGAATGGGGTCATCTCCTTAAGGCCTACCTGCAACAACGCTGGCGCTTTGAA
GTTCCCTTCCTGCACGGCAGCACAAGCAAAACTGAACGTCAGGCCATGGTTGATCGCTTCCAGGAG
GATCCACGTGGACCCCAACTGTTCCTGCTGTCACTCAAAGCCGGTGGTGTAGGCCTCAACCTGACG
CGGGCTAGCCATGTGTTTCATGTTGATCGCTGGTGGAATCCTGCCGTAGAAAACCAGGCCACTGAT
CGCGCTTACAGGATCGGGCAAACCAGTCGGGTGATGGTGCACAAATTCATCACCAGCGGCTCAGTT
GAAGAGAAAATTGATCGCATGATTCGTGAAAAATCTCGACTTGCCGAAGACATCATTGGCTCTGGA
GAAGACTGGTTAGGTGGCTTAGGCGTCAGTCAATTGCGCGAACTAGTGGCCCTAGAAGACAGCTGA

SEQ ID NO: 74, Prochlorococcus marinus str. MIT 9313 Proma MIT 9313 SNF2 translated polypeptide

MIGCGTPAWMVAVDRQCTPAPRNPTHTFCVAAMSLLHATWLPAIRTPTSSGRPALLVWADTWRVAT
PAGPAATPALHPFTLSPDDLRAWLIERDLLPDEIIDATACLTLPSRTVKPRNKTKNVSTESDEAKD
NKTSWTGLPLQAGEPIPKQTEWWPWQVQGLAVEPAAATAWLSKLPLSGNHPDLADELRWWSHLQRW
ALSMIARGRWLPQVELSKGEGYPHRARWTPLLNREDDRRRLEDLAAQLPLVATCALPWREPTGRRS
NRMTRLRPEAMRAANPVASCRPRSGRLRVASLLEELLDAQLRTGFEASEQGLDPLLTAWQEALGSD
SGVINLPDEEAERLATASNHWREGVAGNVAPARACLELFTPGEGEDLWELRFSLQAEADPTIKVPA
AAAWAAGPKVLQLGEIRVEHPGEVLLEGMGRALTVFAPIERGLDSATPEAMQLTPAEAFVLVRTAA
TQLRDVGVGVELPASLSGGLASRLGLAIKAELSERSRGFTLGETLDWSWELMIGGVTLTLRELERL
ASKRSPLVNHKGAWIELRPNDLKHAEHFCSVNPGISLDDALRLTATDGDTLMRLPVHRFEAGPRLQ
AVLEQYHQQKAPDPLPAPEGFCGQLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLLAFLQH
LKAEQELKRPVLLIAPTSVLTNWKREALAFTPELNVREHYGPRRPSTPAALKKALKGLDLVLTSYG
LLQRDSELLETVDWQGVVIDEAQAIKNPNAKQSQAARDMGRPDKNNRFRIALTGTPVENRVSELWA
LMDFLNPRVLGEEDFFRQRYRLPIERYGDMSSLRDLKGRVGPFILRRLKTDKAIISDLPEKVELSE
WVGLSKEQAALYRNTVDETLEAIARAPRGQRHGKVLGLLTRLKQICNHPALALKEQTVAKGFMDRS
AKLLRLEEILEEVIEAGDRALLFTQFAEWGHLLKAYLQQRWRFEVPFLHGSTSKTERQAMVDRFQE
DPRGPQLFLLSLKAGGVGLNLTRASHVFHVDRWWNPAVENQATDRAYRIGQTSRVMVHKFITSGSV
EEKIDRMIREKSRLAEDIIGSGEDWLGGLGVSQLRELVALEDS

SEQ ID NO: 75, Rhodococcus sp. RHA1 Rho_sp_RHA1_SNF2 nucleic acid sequence

ATGGCGCGAGCAGGGACTTCACGCGCTGTCGGTCGCACCTGCTTGGATGGGTGCATGCTGCACGGC
CTCTGGACACCGGGTTCGGGTCTCATGCTGTGGGTGGAGGATCGGAATCCGGCAGCTCCGGAGCCG
ACGGACGCGGTCGGGCGGATGCTGGCGCGGAAGTTCCGGCATCACGTGAAGGTGCCGATGCCGACG
CCGTCGGGGCCGGAGATGCTCGAGTGGGCCGCGGTTGCGCTCGCACCACCGGATGCGACGGAGTTC
CTGCTGTCGGTGTCGTCCCGCGACCCCCGGATCGCCGGGGATCTGCGCTACCTCGCCCACGTCGCC
CGCGGTGTCGAGCGGTGGGCACGGGCCGGGCGGGTGGTGCCCGAGGTACACCGGGCGGAGGGCGGC

FIGURE 10 (continued)

TGGTGGCCGCGCTGGCGGCTGCTCGGCGGTGAACGGCAGCGTGCGTGGCTCACGGAGCTGGCCGTG
GCGATGCCGCCGGTCCAGCGTCACGGCACGACCCCCCGGGCCGTGCTCGACGACATGGTCACCGAG
CTGACCGACCCCGTCGCCCGCCGTGTCCTCGAACGACGGCACCCGGACGATTCCGGCGGCGACGTG
GATCATCCGCTGATCGACGCGCTCGTGCGGGGTGACCAGTTCGCCGAGGGCACCGCCCAGCTGTCG
GGATCGCTGGACGGGTGGCGCGACAGCCTCAAGGTGGACGAGCCCGAACTGGTGCTGCGGCTCCTC
GAGCCGGAAGACGTGGACGTGGAGGGGGATTGGGACCCGGACACGGTGCTGTGGCGACTGGAGGTC
TGCCTTCGACCGGAAGGCGAAGCCCCGGTGCCGATTCCGTTGCACCGCACGGAGGCGAGTCGTCTG
CAGATCGGGGTGCGCAAGCTGACGGAGGCCGTGGCCGCCTACCCGCGACTGCAGGACGTTCCCAGT
GACCCCGACAGCCTGGACCTGATGTTGCCCACCGCCGTGGTCATCGACCTTGTCGGGCACGGTGCG
GTGGCGTTGAAGGAGAAGGGCATCAGCCTGCTGCTGCCGCGGGCGTGGAGTGTGGCGTCGCCGTCG
ATGCGTCTGCGGGTGAGCTCGCCGAGCACTCCGGCGAGCGCGGAGAACCGGGCCGTCGGCAAAGAC
CAGTTGGTGCAATACAACTGGGAGCTGGCACTCGGCGACACGGTGCTCACCGCCGCGGAGATGAAT
CGACTGGTCAACTCCAAGAGCGATCTCGTGCGGTTGCGCGGTGAGTGGGTTCGGGCGGATCAGGAG
GTGCTCTCCCGCGCCGCGCGCTACGTGGCGGAGCGGCACGCCAGCGGCGACCGGGCCATCGTGGAC
CTGCTGAAGGACCTGATCGCGGACGATCTGTCCGATCTTCCCGTGGAGGAGGTCACGGCCACCGGC
TGGGCGGCCGCGTTGCTGGACGGCGACACGAAGCCGCAGGACGTGCCGACCCCGGACGGGTTGGAC
GCCACGCTGCGCCCGTACCAGAAGCGGGGGCTCGACTGGCTGGTGTTCATGAGCCGTCTCGGCCTC
GGGGCCGTCCTCGCCGACGACATGGGACTCGGCAAGACGCTGCAGTTGCTGGCGCTGCTGGCACAC
GAGAAGGCGCCCACGCCCACGCTGCTGGTGTGCCCGATGTCGGTGGTCGGCAACTGGCAGCGCGAG
GCAGCGCGCTTCGTCCCCTCGCTGCGGGTGCTCGTCCACCACGGTCCGCAGCGGCTGAGCGGCGCG
GAGTTCACCGCCGCCGTGACACAGAGCGATCTGGTGATCACCACGTATGCGCTGCTGGCCCGCGAC
GTCGCGCACCTGAAGGAGCAGGACTGGCGGCGTGTCGTGCTGGACGAGGCGCAGCACATCAAGAAC
GCGAAGACGTCGCAGGCGCGGGCGGCGCGGAGCATTCCGGCGGCGCACCGCGTCGCGCTGACCGGC
ACTCCGGTCGAGAACCGCCTCGACGAACTGCGCTCGATCCTCGACTTCGCGAACTCGGGCATCCTG
GGCTCGGAGGTGATGTTCCGCAAGCGCTTCGTGGTGCCGATCGAGCGGGAGCAGGACGAGACAGCC
GTCGCCCGGCTCCGCGCGGTCACGTCCCCGTTCGTGCTGCGCCGGGTCAAGACCGATCCCGCGGTC
ATCGCCGACCTCCCCGACAAGTTCGAGATGACGGTGCGCGCCAACCTCACCGCGGAGCAGGCCGCG
CTGTACCGGGCGGTGGTCGACGACATGATGGCGCAGATCAAGGACAAGAAGGGGATGAAGCGCAAG
GGCGCCGTCCTCGCCGCCCTGACGAAACTCAAGCAGGTGTGCAACCACCCGGCACACTTCCTGCGC
GACGGGTCGGCGGTGATGCGGCGCGGACAGCACCGCTCCGGCAAGCTGGGGCTCGTCGAGGACATC
CTGGATTCCGTGGTCGCGGACGGCGAGAAGGCGTTGCTGTTCACCCAGTTCCGGGAATTCGGCGAC
CTCGTCACCCCGTACCTCGCGGAGCGTTTCGGTACTCCCGTGCCGTTTCTGCACGGGGGCGTGTCC
AAGCAGAAGCGCGACGACATGGTGGCCTCGTTCCAGGGCGACGACGGGCCGCCGATCATGATGCTC
TCGCTGAAGGCGGGCGGGACGGGTTTGAACCTCACCGCGGCCAATCACGTCGTCCACCTCGACCGG
TGGTGGAATCCGGCGGTCGAGAACCAGGCCACGGACAGGGCGTTCCGGATCGGCCAGCGGCGGGAC
GTGCAGGTGCGCAAGCTCGTGTGCGTCGGCACCCTGGAGGAGCGGATCGACGCGATGATCGCCACC
AAGCAGGAGCTGGCCGATCTCGCCGTCGGGACGGGCGAGAACTGGGTGACGGAGATGAGCACCGAA
CAACTGGGCGAACTGCTCCGCCTCGGTGACGAGGCGGTGGGCGAATGA

SEQ ID NO: 76, Rhodococcus sp. RHA1 Rho_sp_RHA1_SNF2 translated polypeptide

MARAGTSRAVGRTCLDGCMLHGLWTPGSGLMLWVEDRNPAAPEPTDAVGRMLARKFRHHVKVPMPT
PSGPEMLEWAAVALAPPDATEFLLSVSSRDPRIAGDLRYLAHVARGVERWARAGRVVPEVHRAEGG
WWPRWRLLGGERQRAWLTELAVAMPPVQRHGTTPRAVLDDMVTELTDPVARRVLERRHPDDSGGDV
DHPLIDALVRGDQFAEGTAQLSGSLDGWRDSLKVDEPELVLRLLEPEDVDVEGDWDPDTVLWRLEV
CLRPEGEAPVPIPLHRTEASRLQIGVRKLTEAVAAYPRLQDVPSDPDSLDLMLPTAVVIDLVGHGA
VALKEKGISLLLPRAWSVASPSMRLRVSSPSTPASAENRAVGKDQLVQYNWELALGDTVLTAAEMN
RLVNSKSDLVRLRGEWVRADQEVLSRAARYVAERHASGDRAIVDLLKDLIADDLSDLPVEEVTATG

FIGURE 10 (continued)

WAAALLDGDTKPQDVPTPDGLDATLRPYQKRGLDWLVFMSRLGLGAVLADDMGLGKTLQLLALLAH
EKAPTPTLLVCPMSVVGNWQREAARFVPSLRVLVHHGPQRLSGAEFTAAVTQSDLVITTYALLARD
VAHLKEQDWRRVVLDEAQHIKNAKTSQARAARSIPAAHRVALTGTPVENRLDELRSILDFANSGIL
GSEVMFRKRFVVPIEREQDETAVARLRAVTSPFVLRRVKTDPAVIADLPDKFEMTVRANLTAEQAA
LYRAVVDDMMAQIKDKKGMKRKGAVLAALTKLKQVCNHPAHFLRDGSAVMRRGQHRSGKLGLVEDI
LDSVVADGEKALLFTQFREFGDLVTPYLAERFGTPVPFLHGGVSKQKRDDMVASFQGDDGPPIMML
SLKAGGTGLNLTAANHVVHLDRWWNPAVENQATDRAFRIGQRRDVQVRKLVCVGTLEERIDAMIAT
KQELADLAVGTGENWVTEMSTEQLGELLRLGDEAVGE

SEQ ID NO: 77, Salinispora tropica CNB-440 Saltr_CNB-440_SNF2 nucleic acid sequence

GTGCTGGTTGTCCACGGGTCGTGGCGGCTCGGCATCGGGCTCGCCATCTGGGCCGAGGACAGCGCG
TCGCCGCCTCGGGCGCCGCGCCGGGCCGGGCGGGCGCCCCGCGAGCGACCCCACCCGTTCGCCGCC
GGTCACCCCGTGCTTGCGGCAGCTCTGGCCGAGGTCGCCGAGCCGACCGAGCCCGGCACGGCACTG
CTCACCCTGCCCACCCGAGCTGGTTCGCCGCTGGACTCGCCGGAGCTGGTCCGCACCGCGTCGGTC
GAGCCGCTCCGTGGGCCGGTCACGTTGGCCGGGTGGCGGGTGCCCGCCCTGGTTTACGCCCCGGAC
GCCGCCCTGTCGCTGCTCTCCCAGATCACCGCGGCCGGCGCTCTACCTGACGCCGTACCCGGTGCC
ACTCTGCGTCACCTCGCGGAGCTGGCGGCCTTCGCCGTGGACCTCGCCGCCCGTGGTCGGGTCCTG
CCCGGCGTCCGGCCACCGAAGGAACGTGCCAGCGCCGCCTGGGCGGTGTGGCAGCCCCTGCTCACC
GGCGTGGACGCTGGCTGGGCCCGGGCCCTCGCCCTCGCCCTGCCGCCCGCGGTCCGTGCCGCCGTC
GAGATCGATCCGGCTCCACTCGCCGTACCCGGCGGACCGGAAACGCCCGCCAACGGTGGTGTGCCG
CCGCAGGCTCGTACGAGGCGACCGACCGCAGCCGCCGGGGAACCAGGTGAACTGGTGGTCGAGGCG
CTCGACGCGCTCACCGACGCGGCCGTACGGGCTGCCCTCGCGGAGACCTCCCTTACCCGGGGAGCC
CGTCCGCGGGGCGCGGTCGCGGCCTGGCTCGCGGCGCTCACCGGCCCGCGTCGTGACTTCACCGCC
GACTCGGCGGAGCTCGACACCCTGCGCGGTGAGTTGGACGCCTGGCAGCGCGACGCTGTGGGAGGT
TCGGTCCGGGCCAGCTTCCGGCTGGTGGAGCCGCCGACGGACGGACTCTTTGAGGCGGCGGCCGGG
GGGCTGGCCGCGGCCGAGGGGTCGTGGCGGGTCGAGTTCGGCCTACAGCCGGCCGACCAGCCGGGT
CTGCATGTTGACGCCGTGCGGATCTGGCACGAGTCGGCGGCCCTACCGGGCCCGGCCGCTCCGCAG
GAGGCCCTGCTGACCGAGTTGGGGCGGGCCAGCCGACTCTGGCCGGAGCTGAACTCGGCCCTGCGC
ACCGCCACTCCAGAGGCGCTGGAGCTGGACGCCGCGGGCGCGCATCGCTTTCTACGCGACGGCGCG
CCGGTGCTGCACGCAGCCGGGTTCGCGGTGCTGTTGCCCTCGTGGTGGCAGCGTCCGTCGTCCCGG
CTCGGCGCTCGACTACAGGCCCAGAGCCGTACCGCCCCGGGCACCGTCGCCGGGGCTGGCGACGGG
GTGGGGTTGGATGCCCTGGTCGACTACCGCTGGGAGGTGTCCCTCGGCGACCAGCCGCTGACCGCC
GAGGAACTGGAGTCGCTGGCCGCGCTGAAATCTCCGTTGGTCCGCCTGCGTGGGCGCTGGGTGGAG
CTGGACCCGAAACGTCTCGCCGCCGGCCTGCGGCTGCTCCGTTCCGCCGGCGAGCTGACCGTCGGC
GACCTGCTGCGGCTCGGCCTCTCCGACCCTGCTACCGACGCGCTGCCGGTGCTCGAGGTGGCGGCC
GACGGTGCGTTGGGTGACTTGCTCGCCGGAGCTGTGGAGCGGCAACTCACCCCGGTGGACGCGGTT
CCGTCGTTCCAGGGCGTTCTCCGCCCCTACCAGCGGCGAGGGCTGGCCTGGCTGTCCTTTCTGCAG
TCCCTCGGCCTCGGCGGGGTGCTCGCTGACGACATGGGTCTCGGCAAGACGGTACAGCTACTCGCG
TTGCTCGCTGGTGACCCGCCGGGCGTCGGTCCGACCCTGTTGGTCTGTCCGATGTCACTGGTCGGT
AACTGGCAGCGGGAGGCGGCGACCTTCACCCCGGGCGTACGGGTCCATGTGCATCACGGCGCCGAG
CGGGCCCGCGGGGCGGCGTTCACCGCGGCGGTGGAGGCAGCGGACCTGGTCCTCACCACCTACACG
GTGGCTGCCCGCGATGCGGGGGAGCTGGCCGGGGTCGACTGGCATCGGGTGGTGGTGGACGAGGCA
CAGGCCATCAAGAACGCCTCGACGCGGCAAGCCGAGGCGGTCCGGGCGTTGCCCGCCCGGCATCGG
ATCGCGGTCACCGGCACCCCGGTGGAGAATCGGCTCGCCGACCTCTGGTCGATCATGCAGTTCGCC
AATCCCGGTCTGCTCGGCCCGGCCGCCGAGTTCAAGAAGCGGTACGCCGAACCGATCGAGCGACAC
GGCGACGCGGAGGCGGCCGAGCGGCTGCGCCGGATCACCGGCCCGTTCGTGCTGCGTCGCCTCAAG

FIGURE 10 (continued)

ACCGACTCTTCGGTTATCTCCGACCTGCCAGAGAAGCTGGAGATGGAGGTGGTGTGCAACCTGACC
GCGGAACAGGCTGCCCTCTACCGTGCGGTGGTGGACGACATGATGGCCCAGATCGAGTCCAGCGAG
GGCATCGAGCGACGTGGGCTCGTGCTGGCCGCCATGACCCGGCTCAAGCAGGTCTGCAACCACCCG
GCGCACCTGCTGCGGGACAACTCGGCGCTGGTCGGCCGCTCCGGCAAGCTGGCCCGGCTGGAGGAG
ATCCTCGACGAGGTGCTTGTCGCGGGGGAGAAGGCCCTGCTCTTCACCCAGTACGCCGAGTTCGGC
GGCATGCTGCGCGGCCACCTGTCGGCCCGGTTCGGACAGGAGACGCTGTTCCTGCACGGCGGCGTC
GGTAAGGCCGACCGGGACGCGATGGTGACGCGGTTCCAGTCCCCGGACGGCCCCGCGCTCTTCGTA
CTCTCGCTCAAGGCCGGTGGTACCGGTCTCACCCTGACCGCGGCCAACCATGTCGTGCACGTTGAC
CGCTGGTGGAATCCGGCGGTGGAGGACCAGGCCACGGACCGGGCGTTCCGCATCGGGCAGCGGCGG
CGCGTTCAGGTCCGCAAGTTTGTCTGCGCCGGCACGGTGGAGGAGAAGGTCGCCGCGCTCATCGCC
GACAAGCGTCGGCTCGCCTCGACGGTGGTGGGTGCCGGTGAGCAGTGGGTTACCGAGCTGTCCACG
GCGCAGCTGCGGGAGCTGTTCCAGCTGGAGTCCGGGGCGGTGGCCGAATGA

SEQ ID NO: 78, Salinispora tropica CNB-440 Saltr_CNB-440_SNF2 translated polypeptide

VLVVHGSWRLGIGLAIWAEDSASPPRAPRRAGRAPRERPHPFAAGHPVLAAALAEVAEPTEPGTAL
LTLPTRAGSPLDSPELVRTASVEPLRGPVTLAGWRVPALVYAPDAALSLLSQITAAGALPDAVPGA
TLRHLAELAAFAVDLAARGRVLPGVRPPKERASAAWAVWQPLLTGVDAGWARALALALPPAVRAAV
EIDPAPLAVPGGPETPANGGVPPQARTRRPTAAAGEPGELVVEALDALTDAAVRAALAETSLTRGA
RPRGAVAAWLAALTGPRRDFTADSAELDTLRGELDAWQRDAVGGSVRASFRLVEPPTDGLFEAAAG
GLAAAEGSWRVEFGLQPADQPGLHVDAVRIWHESAALPGPAAPQEALLTELGRASRLWPELNSALR
TATPEALELDAAGAHRFLRDGAPVLHAAGFAVLLPSWWQRPSSRLGARLQAQSRTAPGTVAGAGDG
VGLDALVDYRWEVSLGDQPLTAEELESLAALKSPLVRLRGRWVELDPKRLAAGLRLLRSAGELTVG
DLLRLGLSDPATDALPVLEVAADGALGDLLAGAVERQLTPVDAVPSFQGVLRPYQRRGLAWLSFLQ
SLGLGGVLADDMGLGKTVQLLALLAGDPPGVGPTLLVCPMSLVGNWQREAATFTPGVRVHVHHGAE
RARGAAFTAAVEAADLVLTTYTVAARDAGELAGVDWHRVVVDEAQAIKNASTRQAEAVRALPARHR
IAVTGTPVENRLADLWSIMQFANPGLLGPAAEFKKRYAEPIERHGDAEAAERLRRITGPFVLRRLK
TDSSVISDLPEKLEMEVVCNLTAEQAALYRAVVDDMMAQIESSEGIERRGLVLAAMTRLKQVCNHP
AHLLRDNSALVGRSGKLARLEEILDEVLVAGEKALLFTQYAEFGGMLRGHLSARFGQETLFLHGGV
GKADRDAMVTRFQSPDGPALFVLSLKAGGTGLTLTAANHVVHVDRWWNPAVEDQATDRAFRIGQRR
RVQVRKFVCAGTVEEKVAALIADKRRLASTVVGAGEQWVTELSTAQLRELFQLESGAVAE

SEQ ID NO: 79, Symbiobacterium thermophilum IAM 14863 Symth_IAM14863_SNF2 nucleic acid sequence

ATGATCACGGTTCACGGCAGTTTCGTCCCCTCCGGCGCGTCCGGCTTCTTCTTCCTGTGGGGCCTG
GACGGCGTGGCCGCCCGGGATGCCGCTCCTCCCGGCCGGCGCCGCCGCGGGGTTCCGCGCCACCCA
TGCGCAACCGAGCCGGAAGCGCTCTACCCCGCCCTGAGAGGATTGCCCTACCTGAACACCCTGTCC
CTGGTCCAGTGGCAGCCCGGACCGGACGGCGTCAGCCCGGCCCGGGTCCCGGGGATCGCCCTGTCC
GTGCCCAACGCCGTGCAGTGGCTGTTGGATCTGCCCGACCACTTCCGCGGCACGCCCCTCCGGCCG
GGGCACAGCCTGCAGCTCTGGTGCGTCGCATCCAAGCTGCTTCTGGAGTTCCTGGGGCGGGGCCTG
ATGCTGCCGGTGCTGCAGGCCGAGGCCGGGGTGCTGAGCGCGGGCTGGGCGCTCCACCTGACCGAC
GCCGACGACGTCCGCCGCCTGACCCGGCTGGCCGCTGGATTGCCGGAGGCCTGCCGCGCCCTTGTG
CCCCCCGACCGAACCCCCAACACCTACCCCCTGCCGGTCGCCGACGGCCTGGTCCACCAGTTCATG
CGTACGGCGGCCGCCGGCGTGATCCGGCTCCTCCTGGAGGAAGAGCCCCTGCCCGAGGCCCAGTCG
CTACAGGATACCGCCCTGCGCCACTGGCTGGCGGCGCTGACCGGGGCGGAGGCCCGGGACCTGCCG
CCGGGCCTGCCCGGCGCGCAGGAGCTGTACGCCGCCCTGGACCGCTGGAGCGCCCCCGCCACCGGC
GTGCTGAGCCACGCCAGTCTGCGGACGGGGGTCCGCCTCCACCTGCCCGGCCCCGAGACCGACGGC
GAGTGGGAGCTGGAGCTCACGCTCCATGCGCCGGACGAGGGTGCGCTGCCCGTCACCGCCGATGCG

FIGURE 10 (continued)

GTCTGGGCCAGCCTGGGCGCCGAGGTGGAGATCGGCGGGCAGCGGTACCAGGGCGCCGAGCAGCGG
CTGCTGGCCGACCTGCCGGCCATGGCCCCGCCTCTTCCCGCCACTGGCGCCGCTGCTCCGGGACCCC
GCGCCCAGCCGCATGCGCATTCCGGCGGACGACGTGCTGGCCCTGATCCAGGAAGGGGCCATGCTG
CTCCAGCAGGCCGGCCACCCCGTGCTGCTGCCGGCCGCCCTTGCGAAGCCCGCCGCCCTCCGGGTC
GGAATGCGCCTCAGCCCCGCCGGGGGCAGCCCCTCCATGTTCGGGCTGCACCAGATCGTGAACGTG
CGCTGGGACGTGGCCCTGGGCGGCACCCCGCTCACGCTGGACGAGCTGCGCCACCTGGCGCGGCAG
AAGCGGCCCCTGGTACAGATGCAGGGCCGGTGGGTGCGGGTGGACGAACGCACCCTGGCTGCGGTC
CTCCGCCGGATCGAGCAGCACGGCGGGCAGATGGAGCTGGGCACGGCGCTGCGCCTGGCACCCGAG
GCGGACGAGGCCACCGCGACCGGCTGGATCGCCGAGCTGCTGGAGCGGCTGCAGGAGCCAGCCCGG
ATGGAGCCGGTGCCGACCCCCGGGGGCTTCGCCGGCACCCTGCGGCCGTACCAGCAGCGGGGCCTC
GCCTGGCTGGCGTTCCTGCGCCGCTGGGGCCTGGGCGCGTGCCTCGCCGACGACATGGGGCTGGGC
AAGACCGTGCAGCTCATCGCCCTTCTCCTGCACGAGCGGGAGGCCGGGTGGGCCGCGGGCCCGACC
CTGCTGGTCTGCCCCGTCTCGGTCCTGGGCAACTGGTGCCGGGAGCTGGCCCGCTTCGCCCCGGGC
CTGCGGGTCCTGGTGCACCATGGCCCCGGGAGGCTGGGCGAGCCGGACTTCGCCCGGCAGGCCGGG
GCCCACGACGTGGTGCTGACCACGTACTCCCTGCTGGCCCGGGATGCCGCGCTGCTGGGCCAGGTG
ACCTGGAACGGGATCGTCGCCGACGAGGCGCAGAACCTGAAAAACCCCGACACACAGCACGCCCGG
GCGCTGCGAAGCCTTTCCGGCGGCTACCGCATCGCCCTCACCGGTACGCCCGTCGAAAACCACCTG
GGCGACCTGTGGTCGCTCTTCCAGTTCCTCAACCCGGGGCTGCTGGGCAGCCGCGAGGAGTTCGAG
CGGCGCTACGCCGTGCCGATCCAGCGGTACCAGGACGAGGAGGCTGCGGCCCGGCTCCGCCGGCAG
GTGGGTCCCTTCATCCTGCGCCGGCAGAAGAACGACCCCGCCATCGCGCCGGACCTGCCCGACAAG
CTGGAGAACACCGAGCTGGTGACCCTCTCGGTGGAACAGGCGGCGCTGTACGAGGCCATCGTGCAG
GAGACGCTGGAGCGGGCCGCGCAGGCCGACGGCATCCAGCGGCAGGCGGCGGTCCTGGCAGGCCTC
ACGCGGCTGAAGCAGGTGTGCAACCATCCCGCAGCCGCCACCGGCGACGGCCCCCTGGTGGGGCGG
AGCGGCAAGATCGACCGGCTGGTGCAACTGCTGCAGGAGGTGCTGGCGGCGGGCGAGCAGGCCCTG
CTCTTCACCCAGTTCGCCCGCTTCGGCGGGCGGCTGCAGGCCTACCTGGCGGAGACGCTGGGCTGC
GAGGTGCTCTTCCTGCACGGCGGCACGCCCCAGCCCGAGCGGGACCGGCTCGTCGCCCGGTTCCAG
GCCGGCGAGGCGCCCCTCTTCATCCTCTCGCTGAAAGCCGGCGGCCTTGGCCTCAACCTCACCGCC
GCGACCCACGTCTTTCACGTGGACCGGTGGTGGAATCCGGCGGTGGAGGATCAGGCCACAGACCGG
GCCTACCGCATCGGCCAGACGCGCAGGGTGCTGGTGCACCGGCTGATCACCGCCGGCACGCTGGAG
GAGCGCATCGACCGGCTGCTGGCCGAGAAGCGTGCCCTGGCGGGCCAGGTGATCATCAGCGGCGAG
TCGTGGCTCGGCCAGCTCTCCACCGAGGAGCTGCGGGCCCTGATCGCCCTGGACCGGGAGGTGTAG

SEQ ID NO: 80, Symbiobacterium thermophilum IAM 14863 Symth_IAM14863_SNF2 translated polypeptide

MITVHGSFVPSGASGFFFLWGLDGVAARDAAPPGRRRRGVPRHPCATEPEALYPALRGLPYLNTLS
LVQWQPGPDGVSPARVPGIALSVPNAVQWLLDLPDHFRGTPLRPGHSLQLWCVASKLLLEFLGRGL
MLPVLQAEAGVLSAGWALHLTDADDVRRLTRLAAGLPEACRALVPPDRTPNTYPLPVADGLVHQFM
RTAAAGVIRLLLEEEPLPEAQSLQDTALRHWLAALTGAEARDLPPGLPGAQELYAALDRWSAPATG
VLSHASLRTGVRLHLPGPETDGEWELELTLHAPDEGALPVTADAVWASLGAEVEIGGQRYQGAEQR
LLADLPAMARLFPPLAPLLRDPAPSRMRIPADDVLALIQEGAMLLQQAGHPVLLPAALAKPAALRV
GMRLSPAGGSPSMFGLHQIVNVRWDVALGGTPLTLDELRHLARQKRPLVQMQGRWVRVDERTLAAV
LRRIEQHGGQMELGTALRLAPEADEATATGWIAELLERLQEPARMEPVPTPGGFAGTLRPYQQRGL
AWLAFLRRWGLGACLADDMGLGKTVQLIALLLHEREAGWAAGPTLLVCPVSVLGNWCRELARFAPG
LRVLVHHGPGRLGEPDFARQAGAHDVVLTTYSLLARDAALLGQVTWNGIVADEAQNLKNPDTQHAR
ALRSLSGGYRIALTGTPVENHLGDLWSLFQFLNPGLLGSREEFERRYAVPIQRYQDEEAAARLRRQ
VGPFILRRQKNDPAIAPDLPDKLENTELVTLSVEQAALYEAIVQETLERAAQADGIQRQAAVLAGL
TRLKQVCNHPAAATGDGPLVGRSGKIDRLVQLLQEVLAAGEQALLFTQFARFGGRLQAYLAETLGC
EVLFLHGGTPQPERDRLVARFQAGEAPLFILSLKAGGLGLNLTAATHVFHVDRWWNPAVEDQATDR
AYRIGQTRRVLVHRLITAGTLEERIDRLLAEKRALAGQVIISGESWLGQLSTEELRALIALDREV

FIGURE 10 (continued)

SEQ ID NO: 81, Synechococcus sp. WH 5701 Syn_sp_WH5701_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTGTCGGCCGACACCGCCGCCGTGCCCGCCCTGGGAGGCGGC
TACCGGCCGGGCTTGCTGCTCTGGGCCGACACCTGGCGGGTGGCGGAACCCCAGACACCGGCCAGC
GAGGCGCCCCAGCACCCCCTCAGCCTCGACCAGGACGACCTCGGCGCCTGGCTTGAGGAGGCCGAC
CTCTGGACGGAGGATTTCCGCCCGGCCGGAGCCACCCTCTGCCTGCCCAGCCGCCGCCAGGGGGCC
AGGGGGAAAAAGAAAAGCGACACCAGCAGCTGGAGCGGCCTGCCCCTGCAGGCGGGCGAGCCGATC
CCGAAATCCGTGGAGTGGTGGCCCTGGCGGGTGGAGGGCTGGTGGCTGGAGCCCGGCGCCGCCACC
CTCTGGCTTGGGCGCCTGCCCCTCTCAGGCGACCATCCCGACCTGGCCGATGACCTGCGCTGGTGG
AGCCATCTGCAGCGCTGGTCGCTGAGCCTGCTGGCCCGGGGCCGGCTGCTGCCCCAGGTGGAGGGG
GGCCGCGCCCCGCTGGCTGCCGTTGATCAACCGCGAAGACGACCGGCGCCGCCTGGAGGATCTGGCC
TCGCGTCTGCCCCAGGTGGCGGTGGCGGCCCTGGAGCCCGGCCAGGGGGAGGCCGGCGTCGCGATG
GCGTGCTGGCGGCCGGGATCCGGGCGTCGGCGGCTGGCCTCGATCCTCACGCACCTGGTGGATGCA
CGCATGCGTGCGGGCTTCACCCCCAGCGAAGAGGGGCTGGATCCGCTGCTGGCGGCCTGGCAGCGG
GCCCTCGGCCCCGGTGACGGCCGCCTCGATCTCGGGGACGACGACTGCGAACGCCTGCAGGTGGCC
ACTCACCACTGGCGCGAAGCGGTGGCTGGCCGGGTCGAGCCGGCCCGGGCCTGTCTTGAGCTCGAC
ACACCCGATGAGGGGGAAGATCTCTGGCCCCTGCGCTTCAGCCTCCAGGCCGAGGCCGATCCCAGT
CTGCTGCTGCCCGCAGCCGGGGTCTGGGCCGCCGGGGCCGGCTGCCTGCAGCTGGGTGAAACCGAA
CTCCAGCAACCCGGTGAACTGCTGCTGGAAGGCCTCGGGAGAGCCCTGCAGGTGTTCGAGCCGATC
GAGAGGGGTCTCGACACCGCCACACCGGAGCGGATGGCTCTCACCCCGGCCGAAGCCTTCGTGCTG
GTGCGCACCGCCGCGCTGAAGCTGCGTGATGTGGGCGTCGGCGTGGTCCTGCCCCCCAGCCTCAGC
GGTGGCCTGGCCAGCCGGCTCGGCCTCTCGATCGAGGCCGATCTGCCCGAGCGCTCCCGCGGCTTC
AGCCTCGGTGAAAGCCTGCAGTGGAGCTGGGAGCTGATGATCGGCGGCGTCACGCTCACCCTGCGG
GACCTGGAGCGGCTGGCGGGCAAGCGCAGCCCGCTGGTGCAGCACAAGGGGGCCTGGATCGAGCTG
CGTCCGGGTGATCTGCGCAATGCCGAGAAGTTCTGCGCCCTCGATCCGGTCCTCAGCCTCGATGAC
GCCCTGCGCCTGACCGGCAACGAGGGGGAGACCCTGCAGCGGCTGCCGGTGCACCGCTTCACAGCC
GGCCCGAGGCTGAAGGCGGTGCTGGAGCAGTACCACCAGCAGAAGGCCCCCGATCCCCTGCCGGCC
CCCGAGGGCTTCGCCGGCCAGCTGCGGCCCTACCAGGAGCGCGGCCTGGGCTGGCTGGCCTTCCTG
CACCGCTTCGATCAGGGGGCCTGCCTGGCCGACGACATGGGCCTGGGCAAGACAATCCAGCTGCTG
GCCTTCCTGCAGCACCTCAAGGCGGAGCAGGAACTGAAGCGTCCCGTACTGCTGGTGGCCCCCACC
TCGGTGCTCACCAACTGGCTGCGGGAAGCGAAGGCCTTCACGCCGGAACTGAACGTGGTGGAGCAC
TACGGCCCCCGGCGGCCCTCCACCCCCGCCGCCCTGAAGAAGAAGCTGGAGGGGATGGATCTGGTG
CTCACCAGCTACGGCCTGCTGCAGCGCGACAGCGAGTTACTGAGCAGCCTCGACTGGCAGGGGGTG
GTGATTGATGAGGCCCAGGCGATCAAGAATTCCTCAGCGCGCCAGTCGCAGGCAGCCCGCGATCTG
GCACGCCCGCTCAAGCAGAGCCGCTTCCGTATCGCACTCACCGGCACCCCGGTGGAGAACCGGGTC
AGTGAGCTCTGGGCCCTGATGGACTTCCTCAATCCGAAGGTGCTTGGGGAGGAGGAGTTCTTCCGC
CAGCGCTACCGCCTGCCGATCGAGCGCTATGGCGACATGGCCTCGGTGCGCGACCTCAAGGCCCGC
GTCGGCCCGTTCATCCTGCGGCGCCTCAAGACTGACCGCTCGATCATCTCCGACCTGCCCGAGAAG
GTGGAACTGAAGGAGTGGGTTGGACTCTCACCCGAGCAGGTCAAGCTCTACCGCCGCACCGTGGAG
GACACCCTCGATGCGATCGCGCGGGCACCCGTGGGCCAGAAGCACGGCCAGGTGCTGGGGCTGCTC
ACCAAGCTCAAGCAGGTCTGCAACCACCCGGCCCTGATGCTCAAGGAAGGGGAGGTGGGGGCCGGC
TTCAGCGCCCGCTCGGCCAAGTTGCAGCGGCTCGAGGAAATCGTCGAGGAGGTGATCGCGGCCGGC
GATCGGGCCCTCCTGTTTACCCAGTTCGCCGAATGGGGCCACCTGCTCCAGACCCACCTGCAGCAG
CGCTTCCACCAGGAGGTGCCCTTTCTCTATGGCAGTACCAGCAAGGGGGAGCGTCAGGCGATGGTG
GATCGCTTCCAGGACGACCCCCGGGGACCACAGCTGTTCCTGCTCTCGCTCAAGGCAGGCGGCGTG
GGGCTCAACCTCACCCGGGCCAGTCATGTGTTCCACATCGACCGCTGGTGGAATCCGGCGGTGGAG
AACCAGGCCACCGACCGGGCCTACCGCATCGGCCAGACCAACCGGGTGATGGTGCACAAGTTCATC
ACCAGCGGCTCGGTGGAGGAGAAGATCGACCGCATGATCCGCGAAAAGGCCCGCCTGGCCGAAGAC
ATCGTCGGCAGCGGTGAGGAGTGGCTCGGAGGCCTCGATCCCGGCCAGCTGCGCGACCTGGTGGCC
CTGGAGGAGTGA

FIGURE 10 (continued)

SEQ ID NO: 82, Synechococcus sp. WH 5701 Syn_sp_WH5701_SNF2 translated polypeptide

MSLLHATWLSADTAAVPALGGGYRPGLLLWADTWRVAEPQTPASEAPQHPLSLDQDDLGAWLEEAD
LWTEDFRPAGATLCLPSRRQGARGKKKSDTSSWSGLPLQAGEPIPKSVEWWPWRVEGWWLEPGAAT
LWLGRLPLSGDHPDLADDLRWWSHLQRWSLSLLARGRLLPQVEGGRARWLPLINREDDRRRLEDLA
SRLPQVAVAALEPGQGEAGVAMACWRPGSGRRRLASILTHLVDARMRAGFTPSEEGLDPLLAAWQR
ALGPGDGRLDLGDDDCERLQVATHHWREAVAGRVEPARACLELDTPDEGEDLWPLRFSLQAEADPS
LLLPAAGVWAAGAGAGCLQLGETELQQPGELLLEGLGRALQVFEPIERGLDTATPERMALTPAEAFVL
VRTAALKLRDVGVGVVLPPSLSGGLASRLGLSIEADLPERSRGFSLGESLQWSWELMIGGVTLTLR
DLERLAGKRSPLVQHKGAWIELRPGDLRNAEKFCALDPVLSLDDALRLTGNEGETLQRLPVHRFTA
GPRLKAVLEQYHQQKAPDPLPAPEGFAGQLRPYQERGLGWLAFLHRFDQGACLADDMGLGKTIQLL
AFLQHLKAEQELKRPVLLVAPTSVLTNWLREAKAFTPELNVVEHYGPRRPSTPAALKKKLEGMDLV
LTSYGLLQRDSELLSSLDWQGVVIDEAQAIKNSSARQSQAARDLARPLKQSRFRIALTGTPVENRV
SELWALMDFLNPKVLGEEEFFRQRYRLPIERYGDMASVRDLKARVGPFILRRLKTDRSIISDLPEK
VELKEWVGLSPEQVKLYRRTVEDTLDAIARAPVGQKHGQVLGLLTKLKQVCNHPALMLKEGEVGAG
FSARSAKLQRLEEIVEEVIAAGDRALLFTQFAEWGHLLQTHLQQRFHQEVPFLYGSTSKGERQAMV
DRFQDDPRGPQLFLLSLKAGGVGLNLTRASHVFHIDRWWNPAVENQATDRAYRIGQTNRVMVHKFI
TSGSVEEKIDRMIREKARLAEDIVGSGEEWLGGLDPGQLRDLVALEE

SEQ ID NO: 83, Synechococcus sp. BL107 Syn_sp_BL107_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTTCCCGCCATTCGTACTTCCAGCAGTTCCGGACAACCGGCA
CTGCTCGTTTGGGCTGACACCTGGCGTGTCGCCTCACCGGAGGGACCTGGACTCACACCCGCTCTG
CATCCCTTCACCCTTGGCTCGAACGATCTCAAGGCTTGGTTGACCGAACGGGACCTGATGCCTGGG
GGCAGCATCGATGCCACCGCCTGCCTCACCCTCCCAAGCCGCACCGTCAAACCCCGCAAAAGTCGA
ACCCAATCGAGCGAACCAGATCCGGAGGGGCCAGCCTGGACCGGGTTGCCAATGCAAGCGGGAGAA
CCCATTCCAAAACAAATGGAATGGTGGCCATGGCAAGTGCAAGGCCTGGCGGTCGAGCCATCGGCC
GCCACGGAATGGCTGGCCCGTTTACCCCTATCGGGCCGACATCCAGACCTTGGGGATGAACTGCGC
TGGTGGAGTCACCTCCAACGTTGGTCCCTCAGCTTGGTGGCCCGTGGTCGCTGGATTCCCCAAATG
GAATTAAGCAAAGGCGAGGGGTACCCCCACCGAGCGCGCTGGGTTCCCCTGCTGAACCGTGAGGAG
GATCGACGCCGGCTCGAAGACCTCGCCGCGACGCTGCCCCTCGTAGCGACCTGTGCCCTCCCTTGG
CGTGAGCCACTCGGACGCCGCAGCAACCGCACCACCAGGCTTCGACCGGAAGCGATGCGAGCCGCC
AATCCGGTCGCCTGCTGTCGCCCACGAAGCGGTCGCCTCAGGGTGGCCACCTTGCTTGAAGACTTG
GTGGATGCGGAGCTGCGCAAGGGATTTGAACCAAGCACGGAAGGCCTCGACCCCTTACTCACCTTG
TGGCAAGAGGCCCTGGCCTCAGAAACCGGTGTTGTGGAGGTGGGCAACGAAGACGCAGAACGCCTC
ACCGCGGCAAGCCTGCACTGGCGCGAGGGAATTGCCGGAGGCTTCGCGGCCGCCCGCACCTGCCTC
GAACTCAACACCCCAAACGAAGGCGAAGAACTCTGGGACCTGAAGTTTGGATTGCAAGCGGAGGCC
GATCCCAGCCTCAAGCTGCCGGCCGCCGCGGCCTGGGCCTCAGGAGCGGAAACCCTTCAACTGGGG
GAAATCCAAGTTGACCAGGCGGGGGAAGTGCTGCTGGAGGGTCTTGGCCGAGCCCTCACGGTGTTC
CCTCCGATCGAACGCGGACTGGAAAGCGCAACACCGGAAACGATGCAGCTCACTCCAGCGGAGGCA
TTTGTGTTGGTGCGAACAGCAACGCACCAGCTCCGCAATGCCGGCATCGGCGTCGAACTGCCCCCC
AGTCTTTCAGGGGGCCTCGCCAGCCGGCTTGGCTTAGCGATTAAAGCGGATCTACCGGATCGATCC
AGCGGCTTCACCCTCGGCGAATCTCTTGACTGGAGCTGGGATCTCATGATCGGCGGCGTCACACTC
ACCCTCCGAGAGCTCGAACGTCTCAGCGGTAAGCGAAGTCCGCTGGTACGCCACAAGGGCGCCTGG
ATCGAACTACGGCCCAACGATCTCCGCAACGCCGAACGCTTTTGTGGAGCCAATCCAGAACTGAGC
CTCGACGACGCACTACGGCTCACGGCCACAGAAGGGGAGCTCATGATGCGCCTGCCGGTGCATCGC
TTTGATGCAGGGCCTCGTCTTCAGGGAGTTCTCGAGCAATACCACCAGCAAAAAGCCCCCGATCCC
CTGCCAGCTCCAGAGGGATTTTCCGGACAACTCCGTCCCTATCAAGAACGTGGCTTGGGCTGGCTG

FIGURE 10 (continued)

GCCTTCCTGCATCGCTTCGATCAGGGCGCCTGCCTGGCGGACGACATGGGCTTGGGCAAGACCATC
CAGTTATTGGCGTTCCTGCAGCACCTCAAAGCGGAAAACGAACTCAAACGCCCGGTGCTGTTGGTG
GCCCCAACCTCGGTGCTCACGAATTGGCGACGGGAAGCGGAAGCCTTCACCCCTGAGCTGTCGGTG
AGAGAGCACTACGGGCCACGCCGGCCTTCCACGCCGGCCGCCTTGAAAAAAGAGCTCAAAGGTGTG
GATCTGGTGCTCACCAGTTACGGACTGATGCAACGCGACAGTGAGCTGCTGGACAACCTCGACTGG
CAAGGGGTTGTGATCGATGAAGCTCAGGCGATCAAGAACCCTGGGGCAAAGCAAAGCCAAGCGGCC
CGAGACCTAGCGCGAGCCGGGAAGAGCAGCAGGTTCCGCATTGCACTCACGGGCACACCGGTGGAA
AACCGCGTCAGCGAGCTGTGGGCGCTGATGGATTTCCTCAACCCCAAAGTGTTGGGTGAGGAAGAC
TTTTTTCGTCAGCGCTACCGCATGCCAATTGAGCGCTACGGCGATATGTCGTCGTTACGCGATCTC
AAAGCACGGGTTGGTCCCTTCATCCTGCGCCGCCTCAAAACCGACAAGTCGATCATTTCCGACCTG
CCTGAAAAGGTGGAGCTCAGCGAATGGGTGGGGCTCAGCAAAGAACAGAAATCGCTGTACAACAAA
ACCGTTGAAGACACCCTCGATGCCATTGCCACCGCACCTCGAGGGCAACGCCATGGCCAGGTGCTG
GCGCTCTTGACCCGTTTAAAACAGATTTGCAATCACCCGGCCTTAGCCCAACGCGAAGGTGCCGTT
GACGCCGAATTCCTTAGCCGGTCCGCCAAGCTCATGCGGCTGGAAGAAATCCTTGAAGAGGTGATT
GAAGCCGGCGATCGCGCTTTGCTGTTCACCCAGTTCGCCGAATGGGGACACCTCTTGCAGGCCTGG
ATGCAACAACGCTGGAAGTCTGAGGTTCCCTTTCTGCACGGCGGAACCCGCAAAAGTGATCGGCAA
GCGATGGTGGATCGATTCCAAGAGGACCCCCGGGGACCTCAACTCTTCCTTCTCTCCCTCAAGGCC
GGTGGTGTTGGCCTAAACCTCACCCGGGCCAGCCACGTGTTCCACGTTGGATCGCTGGTGGAATCC
AGCGGTGGAAAACCAAGCCACCGACCGGGCCTATCGAATTGGTCAAACCAACCGGGTGATGGTGCA
CAAATTCGTCACCCGTGGCTCGGTGGAAGAAAAAATCGACCAAATGATTCGTGA

SEQ ID NO: 84, Synechococcus sp. BL107 Syn_sp_BL107_SNF2 translated polypeptide

MSLLHATWLPAIRTSSSSGQPALLVWADTWRVASPEGPGLTPALHPFTLGSNDLKAWLTERDLMPG
GSIDATACLTLPSRTVKPRKSRTQSSEPDPEGPAWTGLPMQAGEPIPKQMEWWPWQVQGLAVEPSA
ATEWLARLPLSGRHPDLGDELRWWSHLQRWSLSLVARGRWIPQMELSKGEGYPHRARWVPLLNREE
DRRRLEDLAATLPLVATCALPWREPLGRRSNRTTRLRPEAMRAANPVACCRPRSGRLRVATLLEDL
VDAELRKGFEPSTEGLDPLLTLWQEALASETGVVEVGNEDAERLTAASLHWREGIAGGFAAARTCL
ELNTPNEGEELWDLKFGLQAEADPSLKLPAAAAWASGAETLQLGEIQVDQAGEVLLEGLGRALTVF
PPIERGLESATPETMQLTPAEAFVLVRTATHQLRNAGIGVELPPSLSGGLASRLGLAIKADLPDRS
SGFTLGESLDWSWDLMIGGVTLTLRELERLSGKRSPLVRHKGAWIELRPNDLRNAERFCGANPELS
LDDALRLTATEGELMMRLPVHRFDAGPRLQGVLEQYHQQKAPDPLPAPEGFSGQLRPYQERGLGWL
AFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAENELKRPVLLVAPTSVLTNWRREAEAFTPELSV
REHYGPRRPSTPAALKKELKGVDLVLTSYGLMQRDSELLDNLDWQGVVIDEAQAIKNPGAKQSQAA
RDLARAGKSSRFRIALTGTPVENRVSELWALMDFLNPKVLGEEDFFRQRYRMPIERYGDMSSLRDL
KARVGPFILRRLKTDKSIISDLPEKVELSEWVGLSKEQKSLYNKTVEDTLDAIATAPRGQRHGQVL
ALLTRLKQICNHPALAQREGAVDAEFLSRSAKLMRLEEILEEVIEAGDRALLFTQFAEWGHLLQAW
MQQRWKSEVPFLHGGTRKSDRQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHVGSLVES
SGGKPSHRPGLSNWSNQPGDGAQIRHPWLGGRKNRPNDS

SEQ ID NO: 85, Synechococcus sp. CC9311 Syn_sp_CC9311_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTTCCGGCCATTCGTACTCCTACCAGCTCTGGACGAGCTGCC
CTTTTGGTGTGGGCCGACACCTGGCGCGTTGCCGAGCCTGCAGGCCCAAGTACAACCCCTGCGCTT
CACCCGTTCACCCTCAGCCCAGACGATCTCCGGGCCTTGCTCACGGAACGGGATCTTTTACCCGAC
GGCATCATTGATGCCACGGCATGCCTCACCCTGCCGAGCCGCAGCGTGAAGCCCCGAAAAAAACGC
GAAACAGAGACCAGCAGCACTGAACAGCCCAGCTGGACAGGCCTTCCCTTACAGGCTGGAGAACCG
ATCCCCAAACAAACAGAGTGGTGGCCTTGGCAGGTTCAGGGGCTCGCAATTGACCCCATGGCGGCC

FIGURE 10 (continued)

ACCGCCTGGCTGTCCAAACTGCCTCTGTCAGGACGACATCCTGATTTGGCTGATGAGTTGCGCTGG
TGGAGTCACATGCAGCGTTGGTCCCTCAGCCTCGTAGCCCGAAGTCGCTGGCTCCCCCAAGTGGAG
CTGAGCAAGGGCGAGGGCTATCCCCATCGCGCCCGCTGGGTACCGCTTCTGAATCGGGAAGAAGAC
AGGCGCCGTCTAGAAGACTTGGCCGCAGGGCTCCCTCTCGTTGCCACCTGTGCCCTGCCTTGGCGA
GAACCAACGGGCAAACGCAGCAACCGAATCACCAGGCTCAGACCAGAAGCCATGCGCGCCGCGAAT
CCCGTGGCTTGCTGCAGGCCTCGCAGCGGACGACTAAGGGTTGCCACGTTATTGGCCGACCTGATG
GACGCGCAGCTGCGCAAGGGCTTTACTCCTGACCCTGACGGCTTGGACCCCCTGCTACGCGCCTGG
GAGGAGGCCTTGAGCTCGGATACAGGTGAAATCCAACTCAGCGATGAAGAAACCGAACGCCTAGCC
ACCGCCAGTAATCATTGGCGTGAAGGGGTCGCTGGAAATGTTGCTGCAGCCCGCGCCTGCCTGGAG
CTGGCAACACCAGCGGACGATGAGGACCTTTGGCCACTGCGCTTCTTTCTGCAGGCGGAAGCAGAT
CCAACCCTCAAGCTGCCCGCAGGAGCGGCATGGGCTGCAGGCCCCAGCGGCCTCCAACTTGGGGAA
ATCAAGGTGGAGCACCCCAGCGAGGTCTTGCTCGAGGGTATGGGGCGAGCCCTGACCGTGTTCCAA
CCGATCGAGCGCGGACTGGACAGTGCCACGCCAGAGAGCATGCAGCTCACACCAGCTGAAGCGTTT
GTTTTGGTGCGCACAGCAGTCCGACAACTGCGGGATGTGGGCGTTGGCGTTGACCTGCCACCAAGC
CTGTCTGGAGGGCTGGCTAGCAGGCTTGGCCTCGCCATCAAGGCAGAACTCTCCGAGCGTTCGCGA
GGCTTCACGCTCGGTGAAAACCTTGACTGGAGCTGGGAGCTGATGATCGGCGGGGTGACGCTGACC
TTGCGAGAGCTTGAGCGATTGGCTGGTAAGCGCAGCCCTCTGGTGCGTCACAAAGGGGCTTGGATC
GAACTACGGCCCAATGACCTCAAAAATGCCGAGCGCTTTTGCGCCGCCAATCCAGACCTGAGCCTC
GACGACGCGCTTCGGCTCACCGCCACCGAAGGCGACACGATGATGCGCCTGCCCGTGCATCAATTT
GATGCCGGTCCGCGGCTGCAAGCCGTGCTGGAGCAGTACCACCAGCAGAAAGCGCCAGACCCACTC
CCCGCTCCCGAGGGCTTTTCGGGTCAACTCAGGCCCTATCAAGAGAGAGGACTCGGCTGGCTTGCC
TTCCTGCATCGCTTCGACCAAGGCGCCTGCTTGGCCGATGACATGGGCCTTGGCAAAACCATCCAG
CTGCTGGCTTTTCTGCAACACCTCAAGGCAGAAAACGAACTCAAGCGATCAGTGCTTTTAATTGCA
CCCACATCTGTCCTTACGAACTGGAAACGAGAGGCAACAGCGTTTACACCCGAGCTCAAGGTGCAT
GAGCACTACGGTCCAAAACGCCCGAGCACCCCAGCAGCACTGAAAAAGGCGCTGAAAGACGTGGAT
CTCGTGCTCACCAGCTATGGCCTGTTACAACGCGACAGTGAGCTCCTCGAAAGTCACGATTGGCAA
GGCCTCGTGATCGATGAAGCGCAGGCGATAAAAAACCCCTCCGCGAAGCAAAGCCAAGCCGCCCGT
GATCTGGCCCGCCCGAAAAAGAACAGCCGTTTTCGCATCGCACTCACCGGCACACCAGTTGAGAAC
CGCGTCAGCGAGCTCTGGGCCCTGATGGACTTCCTCAACCCTCGGGTACTGGGAGAGGAAGAATTT
TTCCGACATCGCTATCGCATGCCGATTGAGCGTTACGGAGACCTGTCCTCGCTGCGCGACCTCAAA
GCCCGAGTGGGACCTTTCATCCTCAGACGACTCAAAACAGACAAAGCGATCATCTCGGATCTACCC
GAGAAGGTGGAATTGAGCGAGTGGGTTGGGCTGAGCAAAGAGCAGAAGTCGCTGTATGCCAAAACC
GTTGAAGACACCTTGGATGCCATTGCCCGCGCGCCACGCGGCAAACGTCATGGTCAGGTGTTGGGT
CTGCTCACCAAGCTCAAGCAGATTTGCAACCACCCTGCGCTTGCCCTCAAGGAGCAGGGCGCCAGC
GAAGATTTCCTCAAACGGTCCGTGAAGCTGCAACGTCTCGAAGAAATTTTGGACGAGGTTGTAGAA
GCTGGGGATCGAGCCTTGCTGTTTACCCAGTTCGCGGAATGGGGCAAGTTGCTCCAGGATTATTTG
CAACGACGCTGGCGCAGCGAAGTTCCCTTCCTCAGCGGCAGCACCAGCAAAAGTGAACGGCAAGCC
ATGGTCGATCGCTTCCAGGAGGATCCGCGCGGGCCCCAGCTTTTCCTGTTATCACTCAAAGCTGGC
GGAGTCGGCCTCAACCTCACGCGCGCCAGTCATGTCTTTCACATCGACCGTTGGTGGAACCCCGCC
GTTGAAAATCAAGCCACGGACCGTGCCTATCGCATCGGCCAAACGAACCGGGTCATGGTGCATAAG
TTCATCACCAGCGGCTCCGTTGAGGAGAAAATTGACCGCATGATCCGCGAGAAGTCCAGACTGGCG
GAAGACATCATTGGCTCCGGCGAAGACTGGCTTGGAGGCCTGGAAATGGGACAACTCAAAGAGCTA
GTGAGCCTGGAGGACAACCAAGCATGA

FIGURE 10 (continued)

SEQ ID NO: 86, Synechococcus sp. CC9311 Syn_sp_CC9311_SNF2 translated polypeptide

MSLLHATWLPAIRTPTSSGRAALLVWADTWRVAEPAGPSTTPALHPFTLSPDDLRALLTERDLLPD
GIIDATACLTLPSRSVKPRKKRETETSSTEQPSWTGLPLQAGEPIPKQTEWWPWQVQGLAIDPMAA
TAWLSKLPLSGRHPDLADELRWWSHMQRWSLSLVARSRWLPQVELSKGEGYPHRARWVPLLNREED
RRRLEDLAAGLPLVATCALPWREPTGKRSNRITRLRPEAMRAANPVACCRPRSGRLRVATLLADLM
DAQLRKGFTPDPDGLDPLLRAWEEALSSDTGEIQLSDEETERLATASNHWREGVAGNVAAARACLE
LATPADDEDLWPLRFFLQAEADPTLKLPAGAAWAAGPSGLQLGEIKVEHPSEVLLEGMGRALTVFQ
PIERGLDSATPESMQLTPAEAFVLVRTAVRQLRDVGVGVDLPPSLSGGLASRLGLAIKAELSERSR
GFTLGENLDWSWELMIGGVTLTLRELERLAGKRSPLVRHKGAWIELRPNDLKNAERFCAANPDLSL
DDALRLTATEGDTMMRLPVHQFDAGPRLQAVLEQYHQQKAPDPLPAPEGFSGQLRPYQERGLGWLA
FLHRFDQGACLADDMGLGKTIQLLAFLQHLKAENELKRSVLLIAPTSVLTNWKREATAFTPELKVH
EHYGPKRPSTPAALKKALKDVDLVLTSYGLLQRDSELLESHDWQGLVIDEAQAIKNPSAKQSQAAR
DLARPKKNSRFRIALTGTPVENRVSELWALMDFLNPRVLGEEEFFRHRYRMPIERYGDLSSLRDLK
ARVGPFILRRLKTDKAIISDLPEKVELSEWVGLSKEQKSLYAKTVEDTLDAIARAPRGKRHGQVLG
LLTKLKQICNHPALALKEQGASEDFLKRSVKLQRLEEILDEVVEAGDRALLFTQFAEWGKLLQDYL
QRRWRSEVPFLSGSTSKSERQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHIDRWWNPA
VENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKSRLAEDIIGSGEDWLGGLEMGQLKEL
VSLEDNQA

SEQ ID NO: 87, Synechococcus sp. CC9605 Syn_sp_CC9605_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTTCCCGCCATCCGCACCTCCAGCAGTTCCGGTCAACCGGCA
CTGCTCGTTTGGGCTGACACCTGGCGGGTGGCCACACCGGAAGGCCCGGGCCTTACCCCAGCGCTG
CACCCCTTCACCCTAAGCCATGAAGACCTCAGGGCCTGGCTGAGCGAACGCGACCTCTTGCCCGGC
GGCTGCATCGATGCCACGGCGTGCCTCACCCTGCCGAGCCGCACGGTGAAGCTGCGCAAAAGCCGC
AGCACAAAAGAGGAGCCAACACCGGAACCACCGGGTTGGACCGGGCTACCGATGCAGGCCGGCGAA
CCGATCCCCAAGCAAACCGAATGGTGGCCCTGGCAGGTGCAGGGGCTCGCGGTGGAACCGTCGGCA
GCCACGGAGTGGCTGTCCCGATTGCCGCTCTCCGGCACCAATCCAGACCTGGCTGATGAACTGCGC
TGGTGGAGCCATCTGCAGCGCTGGGCCTTGAGTCTGGTGGCCCGGGGCCGCTGGATTCCCCAGATG
GAGTTCAGCAAAGGGGAGGGCTATCCCCATCGGGCCCGTTGGGTGCCGCTTCTCAACCGGGAAGAA
GACCGGCGCCGGCTGGAGGATCTGGCGGCCAGCCTGCCGCTGGTGGCCACCTGCGCCTTGCCCTGG
CGGGAACCCCTGGGGCGCCGCAGCAACCGCACCACCCGGTTACGACCGGAGGCGATGCGAGCCGCC
AACCCTGTGGCCAGCTGCCGGCCCCGCAGCGGACGCCTGCGGGTGGCGACGCTGCTGGAAGATCTA
GTGGACGCGCAGCTGCGCAAGGACTTTGAACCCTCCACCGATGGGCTTGATCCCCTGCTGACCCTC
TGGCAGGAGGCCCTGGGGTCGGAGACCGGGGTGATCGAGATCGGCGATGAAGAGGCCGAACGCCTG
GCCACCGCCAGCCATCACTGGCGGGAGGGCATCGCCGGCGATTTTGCTGCGGCCCGCACCTGCCTT
GAACTGCACACCCCACCGGATGGGGAGGATCTCTGGGAGCTGCGCTTCGGGCTGCAGGCGGAAGCT
GACCCCAGCCTGAAGCTCCCGGCCGCCGCGGCCTGGGCGGCTGGTGCGGAACCGCTACAGCTTGGA
GAGATCCGGGTGGACCAACCGGGTGAAGTGCTGCTGGAAGGCATGGGCCGCGCCCTGAGCGTGTTT
CCGGCAATTGAGCGGGGTCTGGAGAGCGCCACACCTGAAACGATGCAGCTCACCCCGGCCGAGGCC
TTCGTGCTGGTGCGCACGGCCGCCCGGCAGCTGCGGGATGCCGGCGTGGGAGTGGAGCTGCCGCCC
AGCCTCTCCGGTGGCCTGGCCAGCCGACTGGGCCTGTCGATCAAAGCGGAACTGCCCGAACGCTCG
AGCGGTTTCACGTTGGGTGAGTGTCTGGCCTGGGAGTGGGATCTGATGATCGGCGGGGTGACGCTC
ACCCTGCGGGAATTGGAGCGCCTGAGCGGCAAGCGCAGCCCCCTGGTGCGCCACAAGGGGGCCTGG
ATCGAACTGCGGCCCAACGACCTCAAAAATGCCGAACGCTTCTGTGGGGCGAAACCTGAACTGAGC
CTCGACGACGCGCTGCGGCTGACGGGGACGGAAGGGGAACTGTTGATGCGGATGCCGGTGCACCGC
TTCGACGCCGGCCCACGGCTGCAATCGGTGTTGCAGCAATACCACCAGCAGAAGGCCCCCGACCCC

FIGURE 10 (continued)

TTGCCGGCCCCGGAAGGATTCAGCGGGCAGCTGCGGCCTTATCAGGAGCGGGGCCTCGGCTGGCTC
GCCTTCCTGCACCGCTTCGATCAAGGGGCCTGTCTAGCTGACGACATGGGCTTGGGCAAAACCATT
CAGTTGCTAGCGTTCCTGCAGCACCTCAAAGCGGAGCAAGAACTGAAACGCCCGGTGCTGCTGGTG
GCCCCCACATCGGTGCTCACCAACTGGCGACGGGAGGCGGAATCGTTCACTCCAGAGTTGAAGGTC
ACCGAGCATTACGGGCCTCGCCGGCCCTCCACACCCGCCGAACTCAAAAAAGCGTTGAAGGAGGTG
GATCTGGTGCTCACCAGCTACGGGCTGCTGCAGCGTGACAGCGAACTGCTGGAAACCCAGGACTGG
CAGGGGGTGGTGATTGACGAAGCCCAGGCGATCAAGAACCCTGGCGCCAAACAGAGCCAAGCCGCC
CGGGATCTGGCCCGCACCGGCCGCATCAAGAGCAACCGCTTCCGCATCGCACTCACCGGCACCCCC
GTGGAAAACCGGGTGAGCGAACTGTGGGCCTTGATGGACTTCCTCAACCCAAAGGTGCTTGGGGAA
GAAGACTTCTTCCGCCAGCGCTATCGGATGCCGATTGAGCGCTACGGCGACATGTCGTCCCTGCGG
GACCTGAAAGGCCGCGTGGGTCCGTTCATCCTGCGCCGGCTGAAAACCGACAAGACGATCATTTCC
GACCTGCCTGAAAAGGTGGAGCTGAGCGAATGGGTGGGGCTGAGCAAGGAGCAGAAATCTCTGTAC
AGCAAGACCGTGGAAGACACCCTCGATGCCATTGCCCGGGCGCCGCGCGGGCAGCGCCACGGGCAG
GTGCTGGCCCTGCTCACCCGGCTGAAACAGATCTGCAACCATCCCGCCCTGGCCCTGAGCGAAGGG
GCCGTGGACGATGGCTTCCTGGGCCGTTCGGCCAAGCTGCAGCGGCTGGAGGAGATCCTCGATGAG
GTGATCGAAGCGGGCGATCGGGCCCTGCTGTTCACCCAGTTCGCCGAATGGGGGCATTTGCTAAGG
GCCTGGATGCAGCAGCGCTGGAAATCAGAAGTGCCCTTCCTGCACGGCGGCACCCGCAAGAACGAA
CGCCAGGCGATGGTGGATCGCTTCCAGGAGGATCCCCGCGGTCCACAGCTGTTCCTGCTCTCGCTC
AAGGCCGGTGGTGTGGGCCTCAACCTCACGCGGGCCAGCCATGTGTTCCACATCGATCGCTGGTGG
AACCCTGCCGTGGAAAACCAGGCCACCGACCGGGCCTATCGGATCGGCCAAACGAACCGAGTGATG
GTTCATAAATTCATCACCAGCGGTTCGGTGGAGGAAAAAATCGATCGCATGATCCGCGAGAAATCA
CGCCTGGCCGAAGATGTGATCGGCTCCGGCGAAGATTGGCTGGGAAGCCTCGGTGGCGATCAATTG
CGCGATCTCGTTTCTTTGGAGGACACCTGA

SEQ ID NO: 88, Synechococcus sp. CC9605 Syn_sp_CC9605_SNF2 translated polypeptide

MSLLHATWLPAIRTSSSSGQPALLVWADTWRVATPEGPGLTPALHPFTLSHEDLRAWLSERDLLPG
GCIDATACLTLPSRTVKLRKSRSTKEEPTPEPPGWTGLPMQAGEPIPKQTEWWPWQVQGLAVEPSA
ATEWLSRLPLSGTNPDLADELRWWSHLQRWALSLVARGRWIPQMEFSKGEGYPHRARWVPLLNREE
DRRRLEDLAASLPLVATCALPWREPLGRRSNRTTRLRPEAMRAANPVASCRPRSGRLRVATLLEDL
VDAQLRKDFEPSTDGLDPLLTLWQEALGSETGVIEIGDEEAERLATASHHWREGIAGDFAAARTCL
ELHTPPDGEDLWELRFGLQAEADPSLKLPAAAAWAAGAEPLQLGEIRVDQPGEVLLEGMGRALSVF
PAIERGLESATPETMQLTPAEAFVLVRTAARQLRDAGVGVELPPSLSGGLASRLGLSIKAELPERS
SGFTLGECLAWEWDLMIGGVTLTLRELERLSGKRSPLVRHKGAWIELRPNDLKNAERFCGAKPELS
LDDALRLTGTEGELLMRMPVHRFDAGPRLQSVLQQYHQQKAPDPLPAPEGFSGQLRPYQERGLGWL
AFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEQELKRPVLLVAPTSVLTNWRREAESFTPELKV
TEHYGPRRPSTPAELKKALKEVDLVLTSYGLLQRDSELLETQDWQGVVIDEAQAIKNPGAKQSQAA
RDLARTGRIKSNRFRIALTGTPVENRVSELWALMDFLNPKVLGEEDFFRQRYRMPIERYGDMSSLR
DLKGRVGPFILRRLKTDKTIISDLPEKVELSEWVGLSKEQKSLYSKTVEDTLDAIARAPRGQRHGQ
VLALLTRLKQICNHPALALSEGAVDDGFLGRSAKLQRLEEILDEVIEAGDRALLFTQFAEWGHLLR
AWMQQRWKSEVPFLHGGTRKNERQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHIDRWW
NPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKSRLAEDVIGSGEDWLGSLGGDQL
RDLVSLEDT

FIGURE 10 (continued)

SEQ ID NO: 89, Synechococcus sp. CC9902 Syn_sp_CC9902_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTTCCCGCCATTCGTACTTCCAGCAGTTCCGGACAGCCGGCA
CTGCTCATTTGGGCTGACACCTGGCGTGTCGCCTCACCGGAGGGGCCCGGACTCACACCCGCTCTG
CATCCCTTCACCCTTGGCTCGGACGATCTCAAAGCTTGGTTGACCGAACGGGACCTGATGCCTGGG
GGCAGCATCGATGCCACCGCCTGCCTCACCCTCCCAAGCCGCAGCGTCAAACCCCGCAAAAGTCGA
ACCCAACCGAGCGAACCAGCCCCAGAGGGACCGGCCTGGACCGGATTGCCAATGCAAGCAGGAGAG
CCCATTCCGAAGCAAATGGAATGGTGGCCCTGGCAGGTACAAGGCCTCGCGGTGGAGCCATCGGCC
GCAACGGAATGGCTCGCCCGTTTACCCCTATCGGGCCGACATCCAGACCTCGGAGATGAATTGCGC
TGGTGGAGCCATCTCCAACGTTGGTCCCTCAGCTTGGTGGCCCGGGGGCGCTGGATTCCCCAGATG
GAATTAAGCAAAGGCGAGGGTTACCCCCACCGAGCGCGCTGGGTTCCCTTGTTGAACCGTGAGGAA
GATCGACGACGGCTCGAAGACCTCGCGGCCACGCTGCCCCTCGTGGCGACCTGTGCCCTCCCTTGG
CGTGAGCCACTTGGACGCCGTAGCAACCGCACCACCAGGCTTCGACCGGAAGCGATGCGAGCCGCC
AACCCGGTGGCTTGCTGCCGCCCCCGGAGCGGTCGCCTCAGGGTGGCCACCTTGCTTGAAGACTTG
GTGGATGCAGAGCTGCGCAAGGGATTTGAACCCACCACAGAGGGGCTCGACCCCCTACTCACCCTG
TGGCAAGAGGCCCTGGCCTCAGAAACCGGTGTTGTGGAGGTGGGCAACGAGGATGCAGAACGCCTT
ACCGCGGCAAGCCTGCACTGGCGCGAAGGGATTGCCGGAGGCTTCGCTGCTGCCCGCACCTGCCTC
GAACTAAACACCCCAAACGAAGGCGAAGAACTCTGGGACCTGAAGTTTGGCTTGCAAGCGGAGGCC
GATCCCAGCCTCAAGCTGCCGGCCGCCGCGGCCTGGGCCTCAGGAGCCGAAACACTCCAGCTCGGG
GAGATCAAAGTTGACCAGGCGGGGGAAGTGCTGCTGGAGGGTCTTGGCCGAGCCCTCACGGTGTTC
CCTCCGATCGAACGCGGACTGGAAAGCGCAACGCCAGAAACGATGCAGCTCACGCCAGCGGAGGCG
TTTGTCTTGGTGCGAACAGCAACGCACCAGCTCCGCAATGCCGGCATCGGCGTCGAACTGCCCCCC
AGCCTTTCAGGGGGCCTCGCCAGCCGGCTTGGTTTAGCCATCAAGGCAGATTTACCAGATCGATCC
AGCGGCTTCACCCTCGGAGAATCTCTGGACTGGAGCTGGGATCTGATGATCGGCGGCGTCACACTC
ACCCTGCGAGAGCTCGAACGGCTCAGCGGTAAGCGCAGTCCGCTTGTGCGCCACAAGGGAGCCTGG
ATCGAACTGCGACCCAACGATCTCCGCAACGCCGAACGCTTCTGTGGAGCCAATCCAGAACTGAGC
CTCGACGATGCCCTAAGGCTCACGGCCACAGAAGGGGAGCTAATGATGCGCTTGCCGGTGCATCGC
TTTGATGCGGGGCCTCGGCTTCAGGGAGTTCTCGAGCAATATCACCAGCAAAAAGCCCCCGATCCC
CTTCCCGCTCCAGAGGGATTTTCCGGACAACTGCGTCCTTATCAAGAACGTGGCTTGGGCTGGCTG
GCCTTCTTACATCGCTTCGATCAAGGCGCCTGCCTGGCGGACGACATGGGCTTGGGCAAGACCATC
CAATTGTTGGCCTTCCTGCAGCACCTCAAAGCCGAGCACGAACTCAAACGCCCGGTGCTGTTGGTG
GCCCCAACCTCGGTGCTCACGAATTGGCGACGGGAGGCGGAAGCCTTCACCCCCGAGCTGTCGGTG
AAAGAGCACTACGGCCCACGCCGGCCTTCCACGCCGGCCGCCTTGAAAAAAGAACTCAAAGATGTG
GATCTGGTGCTCACCAGTTACGGCCTGATGCAACGCGACAGCGAGCTGCTGGACAGCGTCGACTGG
CAAGGGGTTGTGATCGACGAAGCGCAGGCGATCAAAAACCCTGGGGCGAAACAAAGCCAAGCAGCC
CGAGACCTGGCCCGAGCTGGAAAGAGCAGCAGGTTCCGCATCGCACTCACCGGCACACCGGTGGAA
AACCGCGTCAGCGAGCTGTGGGCGCTGATGGATTTCCTCAACCCAAAGGTGTTGGGAGAGGAAGAC
TTCTTTCGTCAGCGCTACCGCATGCCAATTGAGCGCTACGGCGATATGTCGTCGTTACGCGATCTC
AAAGCGCGGGTCGGCCCCTTCATCCTGCGCCGTCTCAAAACCGACAAGTCGATCATTTCCGACCTG
CCTGAAAAGGTGGAGCTCAGTGAATGGGTGGGTCTCAGCAAAGAACAGAAATCGCTGTACAACAAA
ACCGTTGAAGACACCCTCGACGCCATTGCCACCGCACCGCGGGGGCAACGCCATGGCCAGGTGCTA
GCCCTCTTGACCCGGTTAAAGCAGATTTGCAATCACCCGGCTTTAGCCCAACGCGAAGGGGCCGTT
GACAGCGAATTCCTTGGCCGTTCCGCCAAGCTGATGCGACTCGAAGAAATCCTCGAAGAGGTGATT
GAAGCCGGCGATCGCGCTTTGCTATTCACCCAATTCGCCGAATGGGGGCATCTCCTGCAGGCCTGG
ATGCAACAACGCTGGAAGTCTGAGGTTCCCTTCCTGCACGGCGGAACCCGCAAGAGTGATCGGCAA
GCGATGGTGGATCGATTCCAAGAGGACCCCCGGGGACCTCAACTCTTTCTTCTGTCCCTCAAGGCC
GGTGGTGTAGGCCTCAACCTCACCCGGGCCAGTCATGTGTTCCACGTCGATCGCTGGTGGAATCCA

FIGURE 10 (continued)

GCGGTGGAAAACCAAGCCACCGACCGGGCCTATCGAATTGGTCAAACCAACCGGGTAATGGTGCAC
AAATTCGTCACCCGTGGCTCGGTGGAAGAAAAAATCGACCAAATGATTCGTGAAAAAGCTCGAATG
GCTGAAGACGTGATCGGCTCCGGTGAAGACTGGCTCGGGAGCCTTGGCGGCGATCAGCTGCGCAAT
CTTGTTGCCCTCGAGGACACCTAA

SEQ ID NO: 90, Synechococcus sp. CC9902 Syn_sp_CC9902_SNF2 translated polypeptide

MSLLHATWLPAIRTSSSSGQPALLIWADTWRVASPEGPGLTPALHPFTLGSDDLKAWLTERDLMPG
GSIDATACLTLPSRSVKPRKSRTQPSEPAPEGPAWTGLPMQAGEPIPKQMEWWPWQVQGLAVEPSA
ATEWLARLPLSGRHPDLGDELRWWSHLQRWSLSLVARGRWIPQMELSKGEGYPHRARWVPLLNREE
DRRRLEDLAATLPLVATCALPWREPLGRRSNRTTRLRPEAMRAANPVACCRPRSGRLRVATLLEDL
VDAELRKGFEPTTEGLDPLLTLWQEALASETGVVEVGNEDAERLTAASLHWREGIAGGFAAARTCL
ELNTPNEGEELWDLKFGLQAEADPSLKLPAAAAAWASGAETLQLGEIKVDQAGEVLLEGLGRALTVF
PPIERGLESATPETMQLTPAEAFVLVRTATHQLRNAGIGVELPPSLSGGLASRLGLAIKADLPDRS
SGFTLGESLDWSWDLMIGGVTLTLRELERLSGKRSPLVRHKGAWIELRPNDLRNAERFCGANPELS
LDDALRLTATEGELMMRLPVHRFDAGPRLQGVLEQYHQQKAPDPLPAPEGFSGQLRPYQERGLGWL
AFLHRFDQGACLADDMGLGKTIQLLAFLQHLKAEHELKRPVLLVAPTSVLTNWRREAEAFTPELSV
KEHYGPRRPSTPAALKKELKDVDLVLTSYGLMQRDSELLDSVDWQGVVIDEAQAIKNPGAKQSQAA
RDLARAGKSSRFRIALTGTPVENRVSELWALMDFLNPKVLGEEDFFRQRYRMPIERYGDMSSLRDL
KARVGPFILRRLKTDKSIISDLPEKVELSEWVGLSKEQKSLYNKTVEDTLDAIATAPRGQRHGQVL
ALLTRLKQICNHPALAQREGAVDSEFLGRSAKLMRLEEILEEVIEAGDRALLFTQFAEWGHLLQAW
MQQRWKSEVPFLHGGTRKSDRQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHVDRWWNP
AVENQATDRAYRIGQTNRVMVHKFVTRGSVEEKIDQMIREKARMAEDVIGSGEDWLGSLGGDQLRN
LVALEDT

SEQ ID NO: 91, Synechococcus sp. RS9916 Syn_sp_RS9916_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTCCCGGCCATCCGTACACCCACCAGTTCCGGGCGTGCCGCC
CTGCTGGTGTGGGCGGACACCTGGCGTGTGGCGGAGCCGGCGGGCCCCGGCGTGACCCCGGCCACC
CATCCCTTCACCCTCAGCGCCGATGACCTGCGCGCCTGGCTGAGCGAACGGGAGCTGCTGCCCGAC
GGCATCATCGATGCCACCGCCTGCCTCACCCTGCCCAGCCGCACGGTGAAACCGAAGCGGAAGCGT
GGCGAGACCGCCCCTGTGGATGAGGGCTGGACGGGTCTGCCCCTGCAGGCGGGAGAACCGATTCCG
AAGCAGACCGAATGGTGGCCCTGGCAGGTACAGGGCCTGGCGGTCGAACCCGGTGCAGCCACCGCC
TGGCTGGCCCGCTTGCCCCTCTCCGGCCGCCACCCCGACCTCGCCGATGAGCTGCGCTGGTGGAGC
CACATGCAGCGCTGGGCCCTCAGCCTGATTGCTCGCAGTCGCTGGATTCCCCAGGTGGAGCTGAGC
AAAGGGGAGGGCTACCCCCACCGCGCCCGTTGGGTGCCTCTGCTCAATCGCGAAGACGATCGCCGC
CGCCTGGAAGACATGGCGGCCCGCCTGCCGCTGGTGGCCACCTGCGCTCTCCCCTGGCGCGAACCC
ACCGGGAAGCGCAGCAACCGCACCACCCGGCTGCGGCCTGAGGCGATGCGGGCGGCCAATCCGGTG
GCCTGTTGTCGTCCCCGCAGCGGCCGACTGCGCGTCGCCACCCTGCTCGAAGACCTGGTGGATGCC
CAGCTGCGCACGGGTTTCACAGCCCAGACGGACGGGCTCGATCCCCTGCTTGCCGCCTGGGAGGAG
GCCCTCGGCAGCGACACCGGCGTGATCCACCTGGGCGATGAAGACGCAGAGCGTCTGGCCACCGCC
AGCCATCACTGGCGCGAAGGGGTGGCCGGCACTGTGGCGGCGGCGCGGGCCTGCCTGGAACTGGAG
ACCCCCGACGACGGCGATGACCTCTGGACCCTGCGGTTCGCACTGCAGGCCGAAGCGGATCCCACG
CTCAAGGTGCCGGCCGCCCTCGCCTGGGCGGCCGGTCCGAAGGGACTCCAGCTCGGCGAAATCGCC
GTGGAGCATCCGGGCGAACTGCTGCTGGAAGGCATGGGCCGGGCGCTCACGGTGTTTCCACCGATC
GAACGCGGTCTCGACAGCGCCACGCCGGAAGGGATGCAACTCACCCCGCCGAAGCCTTCGTGCTG
GTGCGCACCGCAGCCCGCGAACTCCGCGATGTGGGGGTGGGCGTGGAGCTTCCAGCCAGCCTCTCG
GGTGGCCTGGCGAGCAGGCTCGGCCTGGCGATTCAGGCGGAACTACCGGAGAAATCCCGCGGTTTC

FIGURE 10 (continued)

ACGCTGGGCGAAACCCTCGACTGGAGCTGGGAGCTGATGATCGGCGGCGTCACCCTGACGCTGCGG
GAACTGGAGCGCCTGGCGGGCAAGCGCAGCCCCCTGGTGCGGCACAAGGGCACCTGGATCGAGCTG
CGCCCCAACGATCTCAAGAATGCGGAGCGGTTTTTCGCCGCGAAGCCCGATCTCAGCCTCGACGAT
GCCCTGCGCCTCACCGCCAGCGAAGGCGACACGCTGATGCGCATGCCGGTGCACCGCCTGGAAGCG
GGCCCACGGCTGCAGGCGGTGCTCGAGCAGTATCACCAACAGAAAGCTCCCGATCCCCTGCCGGCG
CCGGAGGGCTTCTGCGGCCAGCTGCGGCCTTACCAGGAGCGGGGCCTCGGCTGGCTGGCCTTTCTG
CACCGCTTTGATCAAGGCGCCTGCCTGGCCGACGACATGGGTCTGGGCAAGACCATCCAGCTGCTC
GCCTTTCTGCAGCACCTGAAGGCCGAGCAGGAGCTGAAGAGGCCGGTGTTGCTCGTGGCGCCCACC
TCGGTGCTCACCAACTGGAAGCGGGAGGCCGCCGCCTTCACGCCGGAGCTCGAGGTGAAGGAGCAC
TACGGGCCCAGGCGCCCTGCCACCCCTGCAGCACTCAAGAAGAGCCTCAAGGATGTGGATCTGGTG
CTCACCAGCTACGGCCTGCTCCAACGCGACAGCGAACTGCTCGAAAGTCTCGATTGGCAGGGGGTG
GTGATCGACGAAGCGCAGGCAATCAAGAATCCGAGCGCCAAACAGAGCATGGCGGCCCGAGACCTG
GCCCGCGCAGGACGCAGCAGCCGTTTCCGCATTGCCCTCACCGGCACGCCGGTGGAGAACCGGGTG
AGCGAGCTCTGGGCCTTGATGGATTTCCTCAACCCGCGGGTGCTCGGCGAAGAGGACTTCTTCCGC
CAGCGCTACCGCATGCCGATTGAGCGCTATGGCGACATGTCGTCGCTGCGGGATCTGAAATCCCGC
GTGGGACCTTTCATTCTTCGCCGGCTCAAAACCGACAAAGCGATCATTTCCGACCTGCCCGAAAAG
GTGGAACTGAGCGAATGGGTGGGATTGAGCAGGGAGCAGAAAGCGCTCTATGCCAAAACCGTCGAG
GACACCCTCGATGCGATTGCCCGGGCGCCCCGCGGACAACGGCATGGCCAGGTGCTGGGGTTGCTC
ACCAAGCTGAAGCAGATCTGTAACCATCCCGCCCTGGCCCTGAAAGAGGAGGCGGCCGGCGACGAG
TTCCTGCAGCGCTCCATGAAACTGCAGCGCCTGGAGGAAATCCTCGAGGAGGTGATCGACGCCGGC
GACCGCGCCCTGCTCTTCACCCAGTTCGCCGAATGGGGCCATCTGCTGCAGGGTTACCTGCAACGG
CGCTGGCGCAGCGAAGTGCCGTTCCTGAACGGCAGCACCAGCAAGAGCGAACGCCAGGCGATGGTC
GATCGCTTCCAGGAAGACCCGCGGGGGCCTCAGCTGTTCCTGCTGTCACTGAAAGCCGGTGGTGTG
GGCCTCAACCTCACCCGCGCCAGCCATGTGTTTCACATCGATCGCTGGTGGAATCCGGCGGTGGAA
AACCAGGCCACCGACCGCGCCTACCGGATCGGCCAGACGAACCGGGTGATGGTGCACAAGTTCATC
ACCAGTGGATCGGTCGAAGAAAAAATCGACCGGATGATCCGCGAGAAATCACGCCTCGCCGAAGAC
ATCATCGGCTCAGGCGAAGATTGGCTCGGCGGGCTCGACATGGGCCAGCTGAAGGAACTGGTGAGC
CTCGACGACAACGGATCACTTTCAGCATGA

SEQ ID NO: 92, Synechococcus sp. RS9916 Syn_sp_RS9916_SNF2 translated polypeptide

MSLLHATWLPAIRTPTSSGRAALLVWADTWRVAEPAGPGVTPATHPFTLSADDLRAWLSERELLPD
GIIDATACLTLPSRTVKPKRKRGETAPVDEGWTGLPLQAGEPIPKQTEWWPWQVQGLAVEPGAATA
WLARLPLSGRHPDLADELRWWSHMQRWALSLIARSRWIPQVELSKGEGYPHRARWVPLLNREDDRR
RLEDMAARLPLVATCALPWREPTGKRSNRTTRLRPEAMRAANPVACCRPRSGRLRVATLLEDLVDA
QLRTGFTAQTDGLDPLLAAWEEALGSDTGVIHLGDEDAERLATASHHWREGVAGTVAAARACLELE
TPDDGDDLWTLRFALQAEADPTLKVPAALAWAAGPKGLQLGEIAVEHPGELLLEGMGRALTVFPPI
ERGLDSATPEGMQLTPAEAFVLVRTAARELRDVGVGVELPASLSGGLASRLGLAIQAELPEKSRGF
TLGETLDWSWELMIGGVTLTLRELERLAGKRSPLVRHKGTWIELRPNDLKNAERFFAAKPDLSLDD
ALRLTASEGDTLMRMPVHRLEAGPRLQAVLEQYHQQKAPDPLPAPEGFCGQLRPYQERGLGWLAFL
HRFDQGACLADDMGLGKTIQLLAFLQHLKAEQELKRPVLLVAPTSVLTNWKREAAAFTPELEVKEH
YGPRRPATPAALKKSLKDVDLVLTSYGLLQRDSELLESLDWQGVVIDEAQAIKNPSAKQSMAARDL
ARAGRSSRFRIALTGTPVENRVSELWALMDFLNPRVLGEEDFFRQRYRMPIERYGDMSSLRDLKSR
VGPFILRRLKTDKAIISDLPEKVELSEWVGLSREQKALYAKTVEDTLDAIARAPRGQRHGQVLGLL
TKLKQICNHPALALKEEAAGDEFLQRSMKLQRLEEILEEVIDAGDRALLFTQFAEWGHLLQGYLQR
RWRSEVPFLNGSTSKSERQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHIDRWWNPAVE
NQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKSRLAEDIIGSGEDWLGGLDMGQLKELVS
LDDNGSLSA

FIGURE 10 (continued)

SEQ ID NO: 93, Synechococcus sp. WH 7805 Syn_sp_WH7805_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTACCCGCCATCCGCACTCCCAGCAGCTCCGGAAGGGCTGCT
TTGCTGGTATGGGCTGACACCTGGCGTGTGGCCGACCCCCTCGGCCCCGGGGCCACACCCGCCCTT
CATCCGTTCACCCTGAGCGCGGAGGATCTGCGCGCCTGGCTCACAGAGCGCGATTTGCTTCCGGAC
GGAATCATCGATGCGACCGCATGCCTCACCCTGCCGAGCCGCAGTGTGAAACCACGGCGGCCCCGT
GGCTCAGCTGCCGCCACCCCCTCATCAGAAGAGCAGCCCCCTTGGTGCGGGCTGCCGCTGCAAGCC
GGCGAACCGATCCCGAAAACCACCGAGTGGTGGCCATGGCAGGTGCAGGGGCTGGCGATCGAACCG
ATGGCCGCCACGGCATGGCTGGCCAAGCTTCCACTGTCAGGCCATCACCCTGATCTGGCCGATGAG
TTGCGCTGGTGGAGTCACATGCAGCGATGGGCCCTCAGTCTTGTGGCTAGGGGGCGCTGGCTGCCC
CAGGTGGAATTGAGCCGAGGTGAGGGGTATCCACACCGGGCCCGCTGGGTCCCGCTTCTCAATCGA
GAGGAAGACCGGCGCCGCCTGGAGGACCTTGCCGCCCGTCTGCCCCTGGTTGCCACGTGTGCGTTG
CCCTGGAGAGAGCCCACAGGAAAGCGCAGCAATCGCATCACCAGGCTGCGCCCAGAGGCCATGCGC
GCTGCCAATCCCGTGGCCTGCTGTCGTCCCCGCAGCGGTCGATTGCGGGTGGCCACATTGCTGGAG
GATCTGGTAGATGCCCAGCTGCGCAAGGGCTTCCATCCCGATGACGAGGGGCTCGACCCCCTGCTC
TGCGCCTGGGAAAACGCCCTGAGTTCGGAGACCGGGGTGATCGATCTGAATGATGAAGATGCCGAA
CGCCTTGCCACGGCGAGCCACCACTGGCGCGAGGGAGTGGCTGGCAATGTGGCGGCTGCCAGGGCC
TGCCTTGAACTCGCCACACCGAACGAGGGGGAAGAGCTCTGGGATCTGCGCTTCTATCTGCAGGCC
GAAGCCGATCCAACGCTGAAGGTACCGGCCGGAGCAGCCTGGGCCGCTGGACCCGAAGGCCTTCAA
CTCGGGGAGATTCCTGTGGAGCATCCCGGTGAGGTGCTGCTCGAAGGCATGGGGCGTGCTCTCACG
GTGTTCGAACCAATCGAACGGGGCCTGGATAGCGCCACGCCGGAAGCGATGCAGCTCACCCCGGCG
GAAGCCTTCGTGCTGGTGCGCACCGCCGCCCGTCAGCTCCGGGACGTGGGCGTTGGTGTGGATCTC
CCTCCCAGCCTCTCGGGAGGCCTGGCCAGCCGCCTCGGTCTGGCGATCAAGGCCGAACTACCCAAA
CGCTCGCGGGGGTTCACCCTTGGGGAAAATCTCGACTGGAACTGGGAGCTGATGATCGGGGGCGTC
ACCCTGACGCTGCGGGAGCTGGAACGGCTGGCCGGCAAGCGCAGCCCCTTGGTGCGCCACAAGGGG
GCCTGGATCGAACTCAGGCCCAATGATCTCAAAAATGCAGAACGATTCTGTGCCGCCAATCCTGAT
CTGAGCCTGGACGATGCCCTTCGCCTGACGGCCAGCGAAGGGGACACGCTGATGCGCCTCCCCGTT
CATGCCTTTGATGCTGGCCCTCGCCTTCAAGGGGTGTTGGAGCAATACCACCAGCAGAAAGCACCG
GATCCACTTCCTGCGCCCGAGGGTTTCTGCGGTCAGCTTCGCCCTTACCAGGAACGAGGCCTGGGC
TGGCTGGCCTTCCTGCACCGCTTCGATCAGGGAGCCTGCCTCGCCGACGACATGGGCCTGGGCAAG
ACGATCCAGCTGCTGGCCTTCCTCCAGCACCTGAAGATGGAACAAGAACTGAAACGGCCGGTGCTG
CTGGTGGCTCCCACCTCCGTGCTCACCAACTGGAAACGGGAAGCCGCGGCCTTCACCCCCGAGCTC
ACAGTGCATGAGCACTACGGCCCCAAACGACCCTCCACCCCAGCAGCACTGAAAAAAGCCCTGAAA
GACGTTGACCTGGTGCTCACCAGCTACGGGCTTCTGCAAAGAGACAGTGAACTGCTTGAAAGTTTC
GACTGGCAGGGAACCGTGATCGATGAAGCTCAGGCGATCAAGAACCCTTCGGCCAAGCAAAGCCAG
GCAGCCCGTGATCTGGCTCGCACCCGCAAGGGCTCCAGGTTCCGCATTGCCCTCACTGGCACACCG
GTTGAAAACAGAGTGAGCGAGCTCTGGGCCCTGATGGATTTCCTCAATCCGAACGTGCTCGGCGAA
GAGGAATTTTTCCGGCAGCGCTACCGCATGCCGATCGAACGCTATGGCGATATGTCGTCGCTTCGC
GATCTCAAGTCGCGGGTGGGACCATTCATTCTGCGGCGCTTGAAAACCGACAAGGCGATCATCTCC
GACCTCCCCGAAAAAGTGGAGCTGAGTGAATGGGTGGGGCTGAGCAAGGAACAGAAGTCCCTTTAC
GCGAAAACCGTGGAGAACACCCTCGATGCCATCGCCCGAGCTCCCCGAGGCAAGCGTCACGGCCAG
GTGCTGGGACTGCTGACGCGCCTCAAACAGATCTGCAATCACCCGGCTCTGGCCTTAAAGGAAGAG
GTGGCAGGCGACGACTTCCTGCAGCGATCGGTGAAGCTGCAGCGGCTCGAAGAGATTCTCGAAGAG
GTGATTGCAGCGGGGGATCGAGCCCTGCTGTTCACCCAGTTCGCGGAATGGGGGCATCTGCTGCAG
GGCTACCTGCAACGCCGCTGGCGCAGCGAGGTGCCGTTCCTGAGCGGCAGCACTAGCAAAGGAGAA
CGTCAGGCCATGGTGGATCGCTTCCAGGAAGACCCGCGCGGCCCCCAGCTGTTCCTGTTGTCCCTC
AAAGCCGGCGGTGTGGGATTGAACCTGACCCGGGCCAGCCACGTGTTCCACATCGACCGCTGGTGG

FIGURE 10 (continued)

AATCCTGCAGTTGAAAACCAGGCCACTGACCGTGCTTACCGGATTGGCCAGACCAATCGGGTGATG
GTGCATAAGTTCATCACCAGTGGCTCAGTGGAAGAGAAGATCGACCGGATGATCCGGGAGAAGTCC
AGACTGGCGGAAGACATCGTGGGCTCCGGCGAGGAGTGGCTCGGTGGCTTCGACATGGGCCAACTC
AAGGAGCTGGTGAGCCTCGAGGACAACGAAACACGCAACCCATGA

SEQ ID NO: 94, Synechococcus sp. WH 7805 Syn_sp_WH7805_SNF2 translated polypeptide

MSLLHATWLPAIRTPSSSGRAALLVWADTWRVADPLGPGATPALHPFTLSAEDLRAWLTERDLLPD
GIIDATACLTLPSRSVKPRRPRGSAAATPSSEEQPPWCGLPLQAGEPIPKTTEWWPWQVQGLAIEP
MAATAWLAKLPLSGHHPDLADELRWWSHMQRWALSLVARGRWLPQVELSRGEGYPHRARWVPLLNR
EEDRRRLEDLAARLPLVATCALPWREPTGKRSNRITRLRPEAMRAANPVACCRPRSGRLRVATLLE
DLVDAQLRKGFHPDDEGLDPLLCAWENALSSETGVIDLNDEDAERLATASHHWREGVAGNVAAARA
CLELATPNEGEELWDLRFYLQAEADPTLKVPAGAAWAAGPEGLQLGEIPVEHPGEVLLEGMGRALT
VFEPIERGLDSATPEAMQLTPAEAFVLVRTAARQLRDVGVGVDLPPSLSGGLASRLGLAIKAELPK
RSRGFTLGENLDWNWELMIGGVTLTLRELERLAGKRSPLVRHKGAWIELRPNDLKNAERFCAANPD
LSLDDALRLTASEGDTLMRLPVHAFDAGPRLQGVLEQYHQQKAPDPLPAPEGFCGQLRPYQERGLG
WLAFLHRFDQGACLADDMGLGKTIQLLAFLQHLKMEQELKRPVLLVAPTSVLTNWKREAAAFTPEL
TVHEHYGPKRPSTPAALKKALKDVDLVLTSYGLLQRDSELLESFDWQGTVIDEAQAIKNPSAKQSQ
AARDLARTRKGSRFRIALTGTPVENRVSELWALMDFLNPNVLGEEEFFRQRYRMPIERYGDMSSLR
DLKSRVGPFILRRLKTDKAIISDLPEKVELSEWVGLSKEQKSLYAKTVENTLDAIARAPRGKRHGQ
VLGLLTRLKQICNHPALALKEEVAGDDFLQRSVKLQRLEEILEEVIAAGDRALLFTQFAEWGHLLQ
GYLQRRWRSEVPFLSGSTSKGERQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHIDRWW
NPAVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKSRLAEDIVGSGEEWLGGFDMGQL
KELVSLEDNETRNP

SEQ ID NO: 95, Synechococcus sp. WH 8102 Syn_sp_WH8102_SNF2 nucleic acid sequence

ATGAGCCTGCTGCACGCCACCTGGCTTCCCGCCATCCGTACCTCTGGCAGTTCCGGCCAACCGGCA
CTGCTCATTTGGGCTGACACCTGGCGGGTGGCGACACCAGAGGGCCCCGGGCTAACTCCGGCGCTG
CACCCGTTCACCCTGGAACCCGACGACCTCAAGGCCTGGCTTCAGGAACGCGACCTGTTGCCAGGC
GGCAGCATCGATGCCACCGCCTGCCTCACCCTGCCCAGTCGCACGGTAAAACCCCGCAAGAGCCGC
AGCAAAACGGCCGAACCAGCGCCCGAAGAGCCCATCTGGACCGGTCTGCCGATGCAGGCCGGAGAG
CCGATTCCGAAACAGACAGAATGGTGGCCGTGGCAAGTCCAGGGCCTCGCTGTCGAGCCCTCTGCC
GCCACGGAGTGGCTCTCACGCCTTCCCCTGTCAGGACGGAATCCAGACCTGGCCGATGAGCTGCGC
TGGTGGAGCCACCTGCAGCGCTGGGCCCTCAGCCTTGTGGCCCGGGGGCGCTGGATTCCCCAGATG
GAACTGAGCAAAGGCGAGGGATATCCCCACCGGGCCCGTTGGGTGCCTCTGCTCAACCGCGAGGAG
GACCGGCGACGTCTGGAGGATCTGGCCGCCAGCCTGCCGCTGGTGGCCACCTGCGCCCTGCCCTGG
CGGGAACCGATGGGTCGGCGCAGCAACCGCATGACACGGCTGCGTCCGGAGGCCATGCGTGCCGCC
AACCCGGTGGCCTGCTGCCGGCCCCGCAGTGGCCGCCTGCGGGTGGCCACGCTGCTGGAGGATCTG
GTCGACGCACAGCTGCGCAAGGACTTTGAACCATCCACCGACGGCCTCGATCCCCTGTTGACCCTG
TGGCAAGACGCCCTGGGCTCCGAAACAGGGGTGATTGAGATCGGTGATGAACAGGCCGAACGGCTG
GCCAGCGCCAGCTTCCATTGGCGCGAGGGCATCGCTGGAGATTTCGCCGCTGCACGCACCTGCCTG
GAACTGCAGACACCTGCAGAGGGAGAAGAGCTCTGGGAGCTGCGGTTTGGGCTGCAGGCGGAGTCG
GATCCGAGCCTCAAGCTGCCCGCCGCTGCGGCCTGGGCCTCCGGTGCCGACCAACTCCAGTTGGGA
GAAGTGACAGTCGAGCAGCCCGGTGAAGTGCTGCTGGAGGGTCTGGGACGCGCCCTCACCGTGTTC
CCACCGATCGAAAGGGGCCTGGAGACCGCTACGCCTGACACGATGCAGCTGACCCCCGCCGAAGCC
TTCGTGCTGGTGCGGACCGCAGCGCGGCAGCTGCGGGATGCCGGCGTCGGCGTCGACCTTCCCCCC
AGCCTGTCGGGGGGCCTGGCCAGCCGCCTGGGTCTGGCGATCAAGGCGGAGCTGCCAGAGCGCTCC

FIGURE 10 (continued)

AGCGGCTTCAGCCTCGGCGAATCCCTCGACTGGAGCTGGGATCTGATGATCGGCGGGGTGACGCTC
ACCCTGCGGGAACTGGAGCGGTTGAGCGGCAAACGCAGCCCCCTCGTGCGCCACAAGGGGGCCTGG
ATCGAATTGCGACCGAACGATCTGAGAAACGCCGAACGCTTCTGCGGTGCCAACCCGGAGCTCAGC
CTGGACGATGCCCTGCGGATCACCGCCACCGAAGGCGATCTGCTGATGCGTCTGCCGGTGCATCGC
TTTGAGGCCGGCCCCAGGCTGCAGGCGGTGCTGGAGCAGTACCACCAGCAGAAGGCCCCGGATCCG
TTGCCAGCGCCGGAGGGGTTCTGCGGCCAGCTGCGGCCTTACCAGGAGCGTGGCCTGGGCTGGCTG
GCCTTCCTCAACCGCTTCGACCAAGGCGCCTGCCTGGCGGACGACATGGGTCTGGGTAAGACCATC
CAGCTGCTGGCCTTCCTGCAGCACCTGAAAGCAGAGCAGGAACTGAAGCGCCCGGTGCTGCTGGTG
GCCCCCACATCGGTGCTCACAAACTGGCGACGGGAAGCGGAAGCCTTCACCCCCGAACTGGCGGTG
CGCGAGCACTACGGACCGCGGCGTCCCTCCACTCCGGCTGCGCTGAAGAAGGCGTTGAAGGATGTC
GACTTAGTCCTCACCAGCTACGGCCTACTGCAGAGGGACAGTGAATTGCTGGAGTCTCAGGATTGG
CAGGGGGTTGTGATCGATGAAGCCCAAGCGATCAAGAATCCCAGTGCCAAGCAGAGCCAGGCAGCC
CGAGACCTGGCCAGACCAGCCAAAGGCAACCGCTTCCGCATCGCCCTCACGGGCACACCGGTGGAG
AACAGGGTCAGCGAGCTCTGGGCTTTGATGGATTTCCTCAGTCCCAAGGTGCTGGGAGAAGAAGAC
TTCTTCCGTCAGCGCTACCGGATGCCGATCGAGCGCTATGGCGACATGGCATCCCTACGGGACTTA
AAAGCCAGGGTCGGCCCCTTCATCCTGCGCCGGCTGAAAACCGACAAGACGATCATTTCCGATCTG
CCCGAGAAGGTGGAACTCAGCGAATGGGTGGGGTTGAGCAAGGAGCAGAAATCGCTGTACAGCAAA
ACCGTTGAAGACACCCTGGATGCCATTGCCCGGGCGCCTCGTGGACAGCGCCATGGTCAGGTGCTG
GGACTGCTCACCCGCCTGAAGCAGATCTGCAACCATCCGGCCCTGGCATTGAGTGAAAACGCTGTT
GACGACGGCTTTCTGGGGCGCTCCGCCAAGTTGCAACGGCTTGAGGAAATCCTCGATGAGGTGATC
GAAGCAGGGGATCGGGCGCTGCTGTTCACCCAGTTCGCCGAGTGGGGCCATCTGCTGCAGTCCTGG
ATGCAACAACGTTGGAAGGCGGATGTGCCCTTCCTGCATGGAGGGACGCGCAAAAACGAACGGCAG
GCCATGGTGGATCGTTTTCAGGAGGACCCCCGCGGCCCGCAGCTGTTCCTGCTGTCGCTCAAAGCC
GGCGGGGTGGGTCTGAACCTGACCAGGGCCAGCCACGTGTTCCACATCGATCGCTGGTGGAACCCT
GCGGTAGAGAACCAGGCCACCGACCGTGCTTATCGGATCGGCCAGACCAACCGGGTGATGGTGCAC
AAATTCATCACAAGCGGATCCGTAGAAGAAAAAATTGACCGGATGATCCGAGAGAAGTCGCGCCTG
GCAGAGGATGTGATCGGTTCCGGTGAAGACTGGCTCGGGTGCCTGGCCGGTGATCAGCTGCGCAAT
CTCGTTGCCCTGGAGGACACCTGA

SEQ ID NO: 96, Synechococcus sp. WH 8102 yn_sp_WH8102_SNF2 translated polypeptide

MSLLHATWLPAIRTSGSSGQPALLIWADTWRVATPEGPGLTPALHPFTLEPDDLKAWLQERDLLPG
GSIDATACLTLPSRTVKPRKSRSKTAEPAPEEPIWTGLPMQAGEPIPKQTEWWPWQVQGLAVEPSA
ATEWLSRLPLSGRNPDLADELRWWSHLQRWALSLVARGRWIPQMELSKGEGYPHRARWVPLLNREE
DRRRLEDLAASLPLVATCALPWREPMGRRSNRMTRLRPEAMRAANPVACCRPRSGRLRVATLLEDL
VDAQLRKDFEPSTDGLDPLLTLWQDALGSETGVIEIGDEQAERLASASFHWREGIAGDFAAARTCL
ELQTPAEGEELWELRFGLQAESDPSLKLPAAAAWASGADQLQLGEVTVEQPGEVLLEGLGRALTVF
PPIERGLETATPDTMQLTPAEAFVLVRTAARQLRDAGVGVDLPPSLSGGLASRLGLAIKAELPERS
SGFSLGESLDWSWDLMIGGVTLTLRELERLSGKRSPLVRHKGAWIELRPNDLRNAERFCGANPELS
LDDALRITATEGDLLMRLPVHRFEAGPRLQAVLEQYHQQKAPDPLPAPEGFCGQLRPYQERGLGWL
AFLNRFDQGACLADDMGLGKTIQLLAFLQHLKAEQELKRPVLLVAPTSVLTNWRREAEAFTPELAV
REHYGPRRPSTPAALKKALKDVDLVLTSYGLLQRDSELLESQDWQGVVIDEAQAIKNPSAKQSQAA
RDLARPAKGNRFRIALTGTPVENRVSELWALMDFLSPKVLGEEDFFRQRYRMPIERYGDMASLRDL
KARVGPFILRRLKTDKTIISDLPEKVELSEWVGLSKEQKSLYSKTVEDTLDAIARAPRGQRHGQVL
GLLTRLKQICNHPALALSENAVDDGFLGRSAKLQRLEEILDEVIEAGDRALLFTQFAEWGHLLQSW
MQQRWKADVPFLHGGTRKNERQAMVDRFQEDPRGPQLFLLSLKAGGVGLNLTRASHVFHIDRWWNP
AVENQATDRAYRIGQTNRVMVHKFITSGSVEEKIDRMIREKSRLAEDVIGSGEDWLGCLAGDQLRN
LVALEDT

FIGURE 10 (continued)

SEQ ID NO: 97, Synechococcus elongatus PCC 6301 Synel_PCC6301_SNF2 nucleic acid sequence

ATGGCAGTGCTGCACGGTGGCTGGCTCGGCGATCGCTTCTGCGTTTGGGCCGAGGCTTGGCAGGCT
GGTGAGCCTCAGTCGGCAGCAGAAATTGCGATTCATCCCTACGCGATCGCGGCCACTGACTTAAAT
GATTGGTGCCAGAAGTACCGTCTGGGATCCCTGACGGGGACGCCAACAGAAGTCCTGCTCTCTATT
CCCAGTGACCTGAAGAAAGAGGCGGTTCTACCGTTTCTGAGTGGTCAGGAAATTCCAGATGGGGCG
CTGCTTTGGTCTTGGCAGATCCCCGTGCTGTCGCTAGAAGCCGCGATCGCCGGTCAATGGCTGGCG
ACCTTGCCGCTGGGTTCGGCGGAGGATCATCCTTGGCTGGGGCCAGATCTACGCTTTTGGAGCCAC
ATCTACCGCTGGGCACAAAGTTTGCTGGCTCGGGGGCGCTTTTATCCGGCGCTGGAGTCGAGCGAT
CGCGGTTTAACGGCAGTTTGGTTGCCACTGTTTAATCAAGCGGGCGATCGCCAGCGCTTCGATCGC
TATAGTCAGCAGCTGCCCTTTAGTCAGTTTTGCTATCAGGCAATCGAAACAGCGGCAGCTTGTCCT
TGGCAGCCTCAACCGCAGGATCTGTTGCTGCGAGTCCTACAGACTTGGTTGACAGCACGACTACAA
CCGGCGATCGCGGCGGGAACTCTCGTGTCTGCTGATCTGCTGGCGGCTTGGCAGCAATCGCTAGCG
AATGGAAAACCGCTAAAGCTAGAAGACAGTGAAGCCAGTCGCTTGCAAACGGCGATCGATCGCTGG
TTACTACCAGTGCAGAATGGCGCAGCTCAGGCTTGGCGGATGGTTTTGCGCCTTGTCCCGCCTACG
GAGCAAGAGCAGCCCTGGCAATTGGAGTTTGGCTTACAAGCAGCGACCGATCCCGATCGCTTTCGG
CCGGCCTCTCTCCTCTGGCAGGATCCGCTGCCACCTGGGCTACCAGATCAATCTCAGGAATTGCTG
TTACGCGGCTTGGGACAGGCTTGTCGGCTCTATCCCCAATTGCAAACCAGTCTGGCGACAGCCTGT
CCAGAATTCCATCCACTGACCACAGCGGAGGTCTATCAGCTGCTCAAGCAGGTGATTCCTCAGTGG
CAAGAGCAGGGCATTGAAGTGCAACTGCCGCCGGGCTTGCGTGGTCAAGGGCGACACCGGCTGGGA
GTGGAAGTCAGCGCCACGTTGCCGAGCGATCGCCCGAGTGTGGGGCTGGAAGCACTACTGCAGTTT
CGTTGGGAGCTGAGTCTGGGCGGTCAGCGGCTGACCAAAGCAGAAGTGGAACGCTTGGCAGCCCTG
GAAACGCCCTTGGTGGAAATCAACGGCGACTGGATTGAGGTGCGGCCGCAGGATATTGAGTCGGCG
CGAGAGTTTTTCCGTAAGCGCAAGGATCAGCCAAATTTGACCTTGGCGGATGCGATCGCGATCGCC
AGTGGTGAGTCGCCGAATGTTGGTCGCCTGCCGGTGGTCAATTTTGAAGCGGCGGGCTTACTCGAA
GAAGCCTTGGCCGTGTTTCAGGGGCAGCGATCGCCTGCGGCTTTGCCCGCTCCGCCCACCTTTCAG
GGCGAGCTGCGACCCTATCAAGAGCGGGGGGTGGGCTGGCTCAGCTTTTTGCAGCGCTTCGGGATT
GGGGCTTGCCTCGCCGACGACATGGGCTTGGGTAAGACGATTCAGCTGCTGGCCTTTTTACTGCAT
CTCAAACACAGCAACGAGCTGACGCGGCCGGTGCTGCTAGTCTGTCCGACTTCGGTGCTGGGCAAC
TGGGAACGGGAGGTGCAGAAATTTGCACCGGAGCTTCGCTGGAAGCTGCACTATGGCCCCGATCGC
GCTCAGGGTAAGGCTTTGGCGACAGCGCTCAAGGACTGCGATTTGGTGCTGACCAGTTACTCCTTG
GTGGCGCGAGATCAGAAAGCGATCGCGGCGATCGACTGGCAAGGCATTGTGCTGGATGAAGCCCAG
AACATCAAGAATGACCAGGCGAAACAGACGCAGGCGGTGCGAGCGATCGCCCAAAGTCCGACGCAA
AAGCCCCGCTTTCGGATTGCCCTGACAGGGACGCCGGTTGAGAATCGCCTCAGTGAGTTGTGGTCG
ATTGTCGAGTTTTTGCAGCCGGGACATTTAGGCACCAAGCCATTCTTTCAAAAGCGCTTTGTCACG
CCGATCGAGCGTTTTGGCGATGCGGATTCGCTGACAGCATTGCGGCAGCGCGTGCAACCGTTAATC
CTACGGCGACTGAAAACCGATCGCAGCATTATTGCCGACTTGCCTGAGAAGCAAGAAATGACGGTC
TTTTGTCCGTTGGTACAGGAGCAGGCCGATCGCTATCAGGTGCTAGTCAATGAAGCGCTAGCCAAT
ATTGAAGCAAGTGAAGGCATTCAGCGGCGCGGCCAGATTTTGGCATTGCTAACGCGACTGAAGCAG
CTCTGTAATCATCCGTCGTTGTTGCTCGAAAAGCCGAAGCTCGATCCGAATTTTGGCGATCGCTCA
GCCAAGTTGCAGCGCTTACTAGAAATGTTGGCGGAGCTAACGGATGCGGGCGATCGCGCTTTGGTG
TTTACGCAGTTTGCGGGCTGGGGTAGTTTGCTGCAGCAATTTTTGCAGGAACAGCTAGGGCGAGAG
GTGCTGTTTTTGTCGGGCAGTACCAAGAAGGGCGATCGCCAACAGATGGTTGATCGCTTCCAAAAT
GATCCGCAGGCACCGGCAATTTTCATCCTGTCATTGAAGGCTGGCGGGGTGGGGCTCAACCTGACG
AAAGCCAATCATGTCTTTCATTACGATCGCTGGTGGAATCCGGCAGTTGAAAACCAAGCGACCGAT
CGCGCGTTTCGGATTGGGCAACGACGCAATGTACAGGTGCACAAGTTTGTCTGCGCTGGCACTCTA
GAAGAAAAAATTGATCAGATGATCGCTAGCAAGCAAGCATTAGCACAGCAGATTGTCGGTAGTGGT
GAGGATTGGCTAACGGAACTAGACACCAATCAACTCCGGCAACTCTTGATCCTCGATCGCTCAGCT
TGGGTAGAAGAGGAAGAGCCTTAG

FIGURE 10 (continued)

SEQ ID NO: 98, Synechococcus elongatus PCC 6301 Synel_PCC6301_SNF2 translated polypeptide

MAVLHGGWLGDRFCVWAEAWQAGEPQSAAEIAIHPYAIAATDLNDWCQKYRLGSLTGTPTEVLLSI
PSDLKKEAVLPFLSGQEIPDGALLWSWQIPVLSLEAAIAGQWLATLPLGSAEDHPWLGPDLRFWSH
IYRWAQSLLARGRFYPALESSDRGLTAVWLPLFNQAGDRQRFDRYSQQLPFSQFCYQAIETAAACP
WQPQPQDLLLRVLQTWLTARLQPAIAAGTLVSADLLAAWQQSLANGKPLKLEDSEASRLQTAIDRW
LLPVQNGAAQAWRMVLRLVPPTEQEQPWQLEFGLQAATDPDRFRPASLLWQDPLPPGLPDQSQELL
LRGLGQACRLYPQLQTSLATACPEFHPLTTAEVYQLLKQVIPQWQEQGIEVQLPPGLRGQGRHRLG
VEVSATLPSDRPSVGLEALLQFRWELSLGGQRLTKAEVERLAALETPLVEINGDWIEVRPQDIESA
REFFRKRKDQPNLTLADAIAIASGESPNVGRLPVVNFEAAGLLEEALAVFQGQRSPAALPAPPTFQ
GELRPYQERGVGWLSFLQRFGIGACLADDMGLGKTIQLLAFLLHLKHSNELTRPVLLVCPTSVLGN
WEREVQKFAPELRWKLHYGPDRAQGKALATALKDCDLVLTSYSLVARDQKAIAAIDWQGIVLDEAQ
NIKNDQAKQTQAVRAIAQSPTQKPRFRIALTGTPVENRLSELWSIVEFLQPGHLGTKPFFQKRFVT
PIERFGDADSLTALRQRVQPLILRRLKTDRSIIADLPEKQEMTVFCPLVQEQADRYQVLVNEALAN
IEASEGIQRRGQILALLTRLKQLCNHPSLLLEKPKLDPNFGDRSAKLQRLLEMLAELTDAGDRALV
FTQFAGWGSLLQQFLQEQLGREVLFLSGSTKKGDRQQMVDRFQNDPQAPAIFILSLKAGGVGLNLT
KANHVFHYDRWWNPAVENQATDRAFRIGQRRNVQVHKFVCAGTLEEKIDQMIASKQALAQQIVGSG
EDWLTELDTNQLRQLLILDRSAWVEEEEP

SEQ ID NO: 99, Synechococcus elongatus PCC 7942 Synel_PCC7942_SNF2 nucleic acid sequence

ATGGCAGTGCTGCACGGTGGCTGGCTCGGCGATCGCTTCTGCGTTTGGGCCGAGGCTTGGCAGGCT
GGTGAGCCTCAGTCGGCAGCAGAAATTGCGATTCATCCCTACGCGATCGCGGCCACTGACTTAAAT
GATTGGTGCCAGAAGTACCGTCTGGGATCCCTGACGGGGACGCCAACAGAAGTCCTGCTCTCTATT
CCCAGTGACCTGAAGAAAGAGGCGGTTCTACCGTTTCTGAGTGGTCAGGAAATTCCAGATGGGGCG
CTGCTTTGGTCTTGGCAGATCCCCGTGCTGTCACTAGAAGCCGCGATCGCCGGTCAATGGCTGGCG
ACCTTGCCGCTGGGTTCGGCGGAGGATCATCCTTGGCTGGGGCCAGATCTACGCTTTTGGAGCCAC
ATCTACCGCTGGGCACAAAGTTTGCTGGCTCGGGGGCGCTTTTATCCGGCGCTGGAGTCGAGCGAT
CGCGGTTTAACGGCAGTTTGGTTGCCACTGTTTAATCAAGCGGGCGATCGCCAGCGCTTCGATCGC
TATAGTCAGCAGCTGCCCTTTAGTCAGTTTTGCTATCAGGCAATCGAAACAGCGGCAGCTTGTCCT
TGGCAGCCTCAACCGCAGGATCTGTTGCTGCGAGTCCTACAGACTTGGTTGACAGCACGACTACAA
CCGGCGATCGCGGCGGGAACTCTCGTGTCTGCTGATCTGCTGGCGGCTTGGCAGCAATCGCTAGCG
AATGGAAAACCGCTAAAGCTAGAAGACAGTGAAGCCAGTCGCTTGCAAACGGCGATCGATCGCTGG
TTACTACCAGTGCAGAATGGCGCAGCTCAGGCTTGGCGGATGGTTTTGCGCCTTGTCCCGCCTACG
GAGCAAGAGCAGCCCTGGCAATTGGAGTTTGGCTTACAAGCAGCGACCGATCCCGATCGCTTTTGG
CCGGCCTCTCTCCTCTGGCAGGATCCGCTGCCACCTGGGCTACCAGATCAATCTCAGGAATTGCTG
TTACGCGGCTTGGGACAGGCTTGTCGGCTCTATCCCCAATTGCAAACCAGTCTGGCGACAGCCTGT
CCAGAATTCCATCCACTGACCACAGCGGAGGTCTATCAGCTGCTCAAGCAGGTGATTCCTCAGTGG
CAAGAGCAGGGCATTGAAGTGCAACTGCCGCCGGGCTTGCGTGGTCAAGGGCGACACCGGCTGGGA
GTGGAAGTCAGCGCCACGTTGCCGAGCGATCGCCCGAGTGTGGGGCTGGAAGCACTACTGCAGTTT
CGTTGGGAGCTGAGTCTGGGCGGTCAGCGGCTGACCAAAGCAGAAGTGGAACGCTTGGCAGCCCTG
GAAACGCCCTTGGTGGAAATCAACGGCGACTGGATTGAGGTGCGGCCGCAGGATATTGAGTCGGCG
CGAGAGTTTTTCCGTAAGCGCAAGGATCAGCCAAATTTGACCTTGGCGGATGCGATCGCGATCGCC
AGTGGTGAGTCGCCGAATGTTGGTCGCCTGCCGGTGGTCAATTTTGAAGCGGCGGGCTTACTCGAA
GAAGCCTTGGCCGTGTTTCAGGGGCAGCGATCGCCTGCGGCTTTGCCCGCTCCGCCCACCTTTCAG
GGCGAGCTGCGACCCTATCAAGAGCGGGGGGTGGGCTGGCTCAGCTTTTTGCAGCGCTTCGGGATT
GGGGCTTGCCTCGCCGACGACATGGGCTTGGGTAAGACGATTCAGCTGCTGGCCTTTTTACTGCAT
CTCAAACACAGCAACGAGCTGACGCGGCCGGTGCTGCTAGTCTGTCCGACTTCGGTGCTGGGCAAC

FIGURE 10 (continued)

TGGGAACGGGAGGTGCAGAAATTTGCACCGGAGCTTCGCTGGAAGCTGCACTATGGCCCCGATCGC
GCTCAGGGTAAGGCTTTGGCGACAGCGCTCAAGGACTGCGATTTGGTGCTGACCAGTTACTCCTTG
GTGGCGCGAGATCAGAAAGCGATCGCGGCGATCGACTGGCAAGGCATTGTGCTGGATGAAGCCCAG
AACATCAAGAATGACCAGGCGAAACAGACGCAGGCGGTGCGAGCGATCGCCCAAAGTCCGACGCAA
AAGCCCCGCTTTCGGATTGCCCTGACAGGGACGCCGGTTGAGAATCGCCTCAGTGAGTTGTGGTCG
ATTGTCGAGTTTTTGCAGCCGGGACATTTAGGCACCAAGCCATTCTTTCAAAAGCGCTTTGTCACG
CCGATCGAGCGTTTTGGCGATGCGGATTCGCTGACAGCATTGCGGCAGCGCGTGCAACCGTTAATC
CTACGGCGACTGAAAACCGATCGCAGCATTATTGCCGACTTGCCTGAGAAGCAAGAAATGACGGTC
TTTTGTCCGTTGGTACAGGAGCAGGCCGATCGCTATCAGGTGCTAGTCAATGAAGCGCTAGCCAAT
ATTGAAGCAAGTGAAGGCATTCAGCGGCGCGGCCAGATTTTGGCATTGCTAACGCGACTGAAGCAG
CTCTGTAATCATCCGTCGTTGTTGCTCGAAAAGCCGAAGCTCGATCCGAATTTTGGCGATCGCTCA
GCCAAGTTGCAGCGCTTACTAGAAATGTTGGCGGAGCTAACGGATGCGGGCGATCGCGCTTTGGTG
TTTACGCAGTTTGCGGGCTGGGGTAGTTTGCTGCAGCAATTTTTGCAGGAACAGCTAGGGCGAGAG
GTGCTGTTTTTGTCGGGCAGTACCAAGAAGGGCGATCGCCAACAGATGGTTGATCGCTTCCAAAAT
GATCCGCAGGCACCGGCAATTTTCATCCTGTCATTGAAGGCTGGCGGGGTGGGGCTCAACCTGACG
AAAGCCAATCATGTCTTTCATTACGATCGCTGGTGGAATCCGGCAGTTGAAAACCAAGCGACCGAT
CGCGCGTTTCGGATTGGGCAACGACGCAATGTACAGGTGCACAAGTTTGTCTGCGCTGGCACTCTA
GAAGAAAAAATTGATCAGATGATCGCTAGCAAGCAAGCATTAGCACAGCAGATTGTCGGTAGTGGT
GAGGATTGGCTAACGGAACTAGACACCAATCAACTCCGGCAACTCTTGATCCTCGATCGCTCAGCT
TGGGTAGAAGAGGAAGAGCCTTAG

SEQ ID NO: 100, Synechococcus elongatus PCC 7942 Synel PCC7942 SNF2 translated polypeptide

MAVLHGGWLGDRFCVWAEAWQAGEPQSAAEIAIHPYAIAATDLNDWCQKYRLGSLTGTPTEVLLSI
PSDLKKEAVLPFLSGQEIPDGALLWSWQIPVLSLEAAIAGQWLATLPLGSAEDHPWLGPDLRFWSH
IYRWAQSLLARGRFYPALESSDRGLTAVWLPLFNQAGDRQRFDRYSQQLPFSQFCYQAIETAAACP
WQPQPQDLLLRVLQTWLTARLQPAIAAGTLVSADLLAAWQQSLANGKPLKLEDSEASRLQTAIDRW
LLPVQNGAAQAWRMVLRLVPPTEQEQPWQLEFGLQAATDPDRFWPASLLWQDPLPPGLPDQSQELL
LRGLGQACRLYPQLQTSLATACPEFHPLTTAEVYQLLKQVIPQWQEQGIEVQLPPGLRGQGRHRLG
VEVSATLPSDRPSVGLEALLQFRWELSLGGQRLTKAEVERLAALETPLVEINGDWIEVRPQDIESA
REFFRKRKDQPNLTLADAIAIASGESPNVGRLPVVNFEAAGLLEEALAVFQGQRSPAALPAPPTFQ
GELRPYQERGVGWLSFLQRFGIGACLADDMGLGKTIQLLAFLLHLKHSNELTRPVLLVCPTSVLGN
WEREVQKFAPELRWKLHYGPDRAQGKALATALKDCDLVLTSYSLVARDQKAIAAIDWQGIVLDEAQ
NIKNDQAKQTQAVRAIAQSPTQKPRFRIALTGTPVENRLSELWSIVEFLQPGHLGTKPFFQKRFVT
PIERFGDADSLTALRQRVQPLILRRLKTDRSIIADLPEKQEMTVFCPLVQEQADRYQVLVNEALAN
IEASEGIQRRGQILALLTRLKQLCNHPSLLLEKPKLDPNFGDRSAKLQRLLEMLAELTDAGDRALV
FTQFAGWGSLLQQFLQEQLGREVLFLSGSTKKGDRQQMVDRFQNDPQAPAIFILSLKAGGVGLNLT
KANHVFHYDRWWNPAVENQATDRAFRIGQRRNVQVHKFVCAGTLEEKIDQMIASKQALAQQIVGSG
EDWLTELDTNQLRQLLILDRSAWVEEEEP

SEQ ID NO: 101, Thermosynechococcus elongatus BP-1 Theel_BP-1_SNF2 nucleic acid sequence

ATGGCTATTTTCCATGGCACATGGCTCCCAGAGCCGGCGCCACAGTTTTTCATTTGGGCGGAAGAA
TGGCGATCGCTGGCTCAGGCAATCACGCCTTGGGCTCCCCCGGCGATTCCGGTTTATCCCTACGCC
ACCCAGAGAAAAACACCTCTTAGGAAGACAGCCCGCCCAAGTGCCACCTACGTTGCTTTACCGGCC
CAGATTCAGGGGCATCAACTGTTACCACCACCGCTGGCGGAAGTGCAGGGGGAACTCCTATTTTTG
TGGCAGGTGCCCGGCTGGTCAATTCCCGCTTCAGAAGTTTTAGAACAACTGCATCAACTGAGTCTT
CACGGCCAAGACAGTGGCAGTATTGGCGATGATTTGCGCTATTGGCTGCACGTGAGTCGCTGGTTG

FIGURE 10 (continued)

CTGGATTTAATTGTGCGTGGCCAATACCTGCCAACACCAGAGGGCTGGCGGATTCTGCTGACCCAC
GGGGGCGATCGCGATCGCCTGCGCCACTTCAGCCAATTGATGCCGGATCTGTGTCGCTGTTATCAA
GCCGATGGCACAGCGTTGCAGTTGCCACCCCATGCTGCAGATCTCCTGGCGGATTTTCTACAGCAC
ACCCTACAGGGTTATCTCCACACTGCCCTTGCTGACCTCGAATTGCCCAAAGTAGGCTTAGCCAAA
GAACATGGCCACTGGCTAGCCTTCCTGAAAACGGGTCAAACCCCGGAACTGCCACCTCCCCTCATT
GAACGCCTGCACCGCTGGCAAGAACCCTACCGCGAGCAGTTGCATCTGCGTCCCCAATGGCGACTG
GCTCTGCAATTGGTTCCCCCAGATACTGCCGATGGTGACTGGCACTTGGCCTTTGGGCTGCAAACG
GAAGGGGAAACGGACACCATGCTAAGGGCCGCCGAGATTTGGCAATGCACCCAAGAGGCCCTCCTC
TATCAAGGGCAGGTGCTCTGGCAGCCCCAAGAAACCCTGTTGCGGGGACTGGGCTTGGCCTCCCGC
ATCTATCGTCCCCTCGATCGCAGTCTTCAAGAACGCTCCCCCGTGGCTCTGACTTTGCACACCACG
GAAGTTTATGCCTTCTTGCAAAGTGCAATTGCGCCCCTTGAGCAGCAGGGGGTTGCGATCATTTTG
CCACCGAGTCTGCGCCGCAATAGCGCCCAACATCGCTTGGGTCTGAAAATAATTGCCACATTGCCG
CCGCCGGCCACTAACGGCTTGACGATTGACAGCTTGATGCAGTTTCAGTGGCAGTTGCAGTTGGGG
CAGCATCCCCTCTCGGAGGCGGATTTTGATCAACTGCGCCGCCAAGGGACGCCCCTGGTTTATCTC
AATGGTGAGTGGGTCTTGCTGCGCCCCCAAGAGGTCAAGGCCGCTCAAGAGTTTCTCCAGTCTCCC
CCAAAGACCCAACTCTCCCTTGCAGAGACACTGCGCATTGCTACGGGGGATACGGTAACGGTGGCC
AAGTTGCCGATTCTTGGCTTAGACACCAATGATGCACTCCAGACCCTCTTGGATGGCCTCACGGGC
AAACAAAGCCTTGATCCAGTGCCAACACCGCAGGAGTTTTGCGGTGAACTGCGCCCCTACCAGGCA
CGGGGGGTGGCGTGGCTGAGTTTCTTGGAACGCTGGCGGCTGGGGGCTTGCTTGGCGGACGATATG
GGCTTGGGGAAAACCATTCAACTGTTGGCCTTTTTGCTCCACCTCAAGGAAACGGGACGGGCCTAC
CGACCGACACTGTTGATCTGTCCTACCTCGGTGCTGGGGAACTGGCTGCGGGAGTGCCAAAAGTTT
GCCCCAACCTTGCGGGCCTATGTCCACCATGGGAGCGATCGCCCCAAGGGCAAGGCATTTCTGAAA
AAGGTTGAAACTCACGATCTAATTTTGACCAGTTATGCCCTCCTCCAGCGCGATCGCACCACCTTG
CAGCAGGTTCTGTGGCAGCATTTGGTACTGGATGAAGCCCAAAACATCAAGAATGCCAACACCCAG
CAGTCCCAAGCAGCGCGGGAACTTTCCGCCCAGTTTCGCATTGCCCTGACGGGAACCCCCCTAGAA
AACCGCCTCCTCGAACTTTGGTCCATTATGGACTTCCTCCATCCGGGGTACTTGGGCCATCGCACC
TACTTTCAACACCGCTATGTCCGTCCCATTGAACGCTATGGCGACACCACCTCCCTCAATGCTCTG
CGCACCTATGTCCAGCCCTTTATTCTGCGGCGCCTGAAAACCGACCGCAGTATTATTCAAGACCTG
CCGGAAAAACAGGAGATGCTGGTGTATTGTGGCCTCACCCTAGAGCAGATGCAGCTTTACACTGCT
GTGGTGGAAGACTCCCTTGCTGCTATCGAAAATAGTCAAGGCATTCAGCGGCGGGGCAATATCTTG
GCCACCCTGACCAAGTTGAAGCAAATCTGTAACCATCCCGCCCAGTATCTCAAGCAAGAAGACTAT
GCCCCCGATCGCTCAGGTAAATTGCAACGGCTTATAGAAATGCTGCAAGCGCTTCAGGAAGTGGGC
GATCGCGCCCTTGTCTTTACCCAATTTGCCGAGTTTGGCACCCACCTGAAAACCTATCTGGAAAAG
GCGCTCCAGCAGGAGGTGTTTTTCCTCTCAGGACGCACCCCCAAAGCCCAGCGGGAACTCATGGTG
GAACGCTTTCAACACGATCCCGAGGCCCCCAGGGTCTTTATTCTTTCCCTCAAGGCAGGGGGCGTC
GGTCTCAATTTGACTCGCGCTAACCATGTCTTTCACTACGATCGCTGGTGGAACCCAGCGGTAGAA
AATCAGGCCAGCGATCGCGTCTTCCGCATTGGTCAGGCCCGCAATGTCCAAATCCATAAATTTATC
TGCACGGGTACCCTCGAAGAAAAGATCCACGAGCAAATCGAACAGAAAAAAGCCCTTGCGGAAATG
ATTGTGGGTAGTGGCGAACACTGGCTGACTGAACTCAACCTCGACCAGTTGCGGCAACTGCTCACC
TTAGACAAAGAGCGGCTGATCACCCTCTAG

SEQ ID NO: 102, Thermosynechococcus elongatus BP-1 Theel_BP-1_SNF2 translated polypeptide

MAIFHGTWLPEPAPQFFIWAEEWRSLAQAITPWAPPAIPVYPYATQRKTPLRKTARPSATYVALPA
QIQGHQLLPPPLAEVQGELLFLWQVPGWSIPASEVLEQLHQLSLHGQDSGSIGDDLRYWLHVSRWL
LDLIVRGQYLPTPEGWRILLTHGGDRDRLRHFSQLMPDLCRCYQADGTALQLPPHAADLLADFLQH
TLQGYLHTALADLELPKVGLAKEHGHWLAFLKTGQTPELPPPLIERLHRWQEPYREQLHLRPQWRL
ALQLVPPDTADGDWHLAFGLQTEGETDTMLRAAEIWQCTQEALLYQGQVLWQPQETLLRGLGLASR

FIGURE 10 (continued)

IYRPLDRSLQERSPVALTLHTTEVYAFLQSAIAPLEQQGVAIILPPSLRRNSAQHRLGLKIIATLP
PPATNGLTIDSLMQFQWQLQLGQHPLSEADFDQLRRQGTPLVYLNGEWVLLRPQEVKAAQEFLQSP
PKTQLSLAETLRIATGDTVTVAKLPILGLDTNDALQTLLDGLTGKQSLDPVPTPQEFCGELRPYQA
RGVAWLSFLERWRLGACLADDMGLGKTIQLLAFLLHLKETGRAYRPTLLICPTSVLGNWLRECQKF
APTLRAYVHHGSDRPKGKAFLKKVETHDLILTSYALLQRDRTTLQQVLWQHLVLDEAQNIKNANTQ
QSQAARELSAQFRIALTGTPLENRLLELWSIMDFLHPGYLGHRTYFQHRYVRPIERYGDTTSLNAL
RTYVQPFILRRLKTDRSIIQDLPEKQEMLVYCGLTLEQMQLYTAVVEDSLAAIENSQGIQRRGNIL
ATLTKLKQICNHPAQYLKQEDYAPDRSGKLQRLIEMLQALQEVGDRALVFTQFAEFGTHLKTYLEK
ALQQEVFFLSGRTPKAQRELMVERFQHDPEAPRVFILSLKAGGVGLNLTRANHVFHYDRWWNPAVE
NQASDRVFRIGQARNVQIHKFICTGTLEEKIHEQIEQKKALAEMIVGSGEHWLTELNLDQLRQLLT
LDKERLITL

SEQ ID NO: 103, Motif 1
LADDMGLGK(T/S)

SEQ ID NO: 104, Motif 1a
L(L/V/I)(V/I/L)(A/C)P(T/M/V)S(V/I/L)(V/I/L)XNW

SEQ ID NO: 105, Motif 2
DEAQ(N/A/H)(V/I/L)KN

SEQ ID NO: 106, Motif 3
A(L/M)TGTPXEN

SEQ ID NO: 107, Motif 4
(L/I)XF(T/S)Q(F/Y)

SEQ ID NO: 108, Motif 5
S(L/V)KAGG(V/T/L)G(L/I)(N/T)LTXA(N/S/T)HV

SEQ ID N0: 109, Motif 5a
DRWWNPAVE

SEQ ID N0: 110, Motif 6
QA(T/S)DR(A/T/V)(F/Y)R(I/L)GQ

SEQ ID NO: 111, ATPase domain of SEQ ID NO: 2
LADDMGLGKTPQLLAFLLHLAAEDMLVKPVLIVCPTSVLSNWGHEINKFAPQLKTLLHHGDRRKKG
QPLVKQVKDQQIVLTSYALLQRDFSSLKLVDWQGIVLDEAQNIKNPQAKQSQAARQLPAGFRIALT
GTPVENRLTELWSILEFLNPGFLGNQSFFQRRFANPIEKFGDRQSLLILRNLVRPFILRRLKTDQT
IIQDLPEKQEMTVFCDLSQEQAGLYQQLVEESLQAIADSEGIQRHGLVLTLLTKLKQVCNHPDLLL
KKPAITHGHQSGKLIRLAEMLEEIISEGDRVLIFTQFASWGHLLKPYLEKYFNQEVLYLHGGTPAE
QRQALVERFQQDPNSPYLFILSLKAGGTGLNLTRANHVFHVDRWWNPAVENQATDRAFRIGQTRNV
QVHKFVCTGTLEEKINAMMADKQQLAEQTVDAGENWLTRLDTDKLRQLLTLSATPVDYQAEASD

FIGURE 10 (continued)

SEQ ID NO: 112, Oryza sativa beta-expansin promoter

AAAACCACCGAGGGACCTGATCTGCACCGGTTTTGATAGTTGAGGGACCCGTTGTGTCTGGTTTTC
CGATCGAGGGACGAAAATCGGATTCGGTGTAAAGTTAAGGGACCTCAGATGAACTTATTCCGGAGC
ATGATTGGGAAGGGAGGACATAAGGCCCATGTCGCATGTGTTTGGACGGTCCAGATCTCCAGATCA
CTCAGCAGGATCGGCCGCGTTCGCGTAGCACCCGCGGTTTGATTCGGCTTCCCGCAAGGCGGCGGC
CGGTGGCCGTGCCGCCGTAGCTTCCGCCGGAAGCGAGCACGCCGCCGCCGCCGACCCGGCTCTGCG
TTTGCACCGCCTTGCACGCGATACATCGGGATAGATAGCTACTACTCTCTCCGTTTCACAATGTAA
ATCATTCTACTATTTTCCACATTCATATTGATGTTAATGAATATAGACATATATATCTATTTAGAT
TCATTAACATCAATATGAATGTAGGAAATGCTAGAATGACTTACATTGTGAATTGTGAAATGGACG
AAGTACCTACGATGGATGGATGCAGGATCATGAAAGAATTAATGCAAGATCGTATCTGCCGCATGC
AAAATCTTACTAATTGCGCTGCATATATGCATGACAGCCTGCATGCGGGCGTGTAAGCGTGTTCAT
CCATTAGGAAGTAACCTTGTCATTACTTATACCAGTACTACATACTATATAGTATTGATTTCATGA
GCAAATCTACAAAACTGGAAAGCAATAAGAAATACGGGACTGGAAAAGACTCAACATTAATCACCA
AATATTTCGCCTTCTCCAGCAGAATATATATCTCTCCATCTTGATCACTGTACACACTGACAGTGT
ACGCATAAACGCAGCAGCCAGCTTAACTGTCGTCTCACCGTCGCACACTGGCCTTCCATCTCAGGC
TAGCTTTCTCAGCCACCCATCGTACATGTCAACTCGGCGCGCGCACAGGCACAAATTACGTACAAA
ACGCATGACCAAATCAAAACCACCGGAGAAGAATCGCTCCCGCGCGCGGCGGCGACGCGCACGTAC
GAACGCACGCACGCACGCCCAACCCCACGACACGATCGCGCGCGACGCCGGCGACACCGGCCGTCC
ACCCGCGCCCTCACCTCGCCGACTATAAATACGTAGGCATCTGCTTGATCTTGTCATCCATCTCAC
CACCAAAAAAAAAAGGAAAAAAAAACAAAACACACCAAGCCAAATAAAAGCGACAA

SEQ ID NO: 113, Prm 08774

GGGGACAAGTTTGTACAAAAAAGCAGGCTTAAACAATGGCGACTATCCACGGTAATTGG

SEQ ID NO: 114, Prm 08779

GGGGACCACTTTGTACAAGAAAGCTGGGTTCAATCGGACGCTTCGGCTT

FIGURE 10 (continued)

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(71) Applicants *(for all designated States except US)*: **CROPDESIGN N.V.** [BE/BE]; Technolopark 3, B-9052 Zwijnaarde (BE). **CROP FUNCTIONAL GENOMICS CENTER** [KR/KR]; San 56-1, Shillim 9-Dong, Gwanak-Gu, Seoul 151-921 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CHOI, Yang Do** [KR/KR]; Banppo Tower Apt 102-301, Jamwon-dong, Seocho-ku, Seoul 137-909 (KR). **PARK, Youn-Il** [KR/KR]; Jijok dong 919, 705-401, Youseong, Daejeon 305-330 (KR). **CHUNG, Suck Won** [KR/KR]; Noeun 559-10, Youseong, Daejeon 305-325 (KR). **HWANG, In Gyu** [KR/KR]; San 56-1, Shillim 9-Dong, Gwanak-Gu, Seoul 151-921 (KR). **OH, Jonghee** [KR/KR]; San 56-1, Shillim 9-Dong, Gwanak-Gu, Seoul 151-921 (KR).

(74) Agent: **MISTRY, Meeta**; Basf Se, Global Intellectual Property, Gvx - C006, 67056 Ludwigshafen (DE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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— *with sequence listing part of description published separately in electronic form and available upon request from the International Bureau*

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(54) Title: PLANTS HAVING ENHANCED YIELD-RELATED TRAITS AND A METHOD FOR MAKING THE SAME

(57) Abstract: The present invention relates generally to the field of molecular biology and concerns a method for enhancing various economically important yield-related traits in plants. More specifically, the present invention concerns a method for enhancing yield-related traits in plants by modulating expression in a plant of a nucleic acid encoding a Harpin-a ssociated Factor G polypeptide (hereinafter termed HpaG"). The present invention also concerns plants having modulated expression of a nucleic acid encoding an HpaG polypeptide, which plants have enhanced yield-related traits relative to control plants. The invention also provides constructs comprising HpaG-encoding nucleic acids, useful in performing the methodsof the invention. The present invention also provides a method for enhancing yield-related traits in plants relative to control plants, by modulating (preferably increasing) expression in a plant of a nucleic acid sequence encoding a SWITCH 2/ SUCROSE NON-FERMENTING 2 (SWI2/SNF2) polypeptide. The present invention also concerns plants having modulated expression of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide, which plants have enhanced yield-related traits relative to control plants. The invention also provides constructs useful in performing the methods of the invention.

WO 2008/104598 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/052450

A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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C12N A01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, BIOSIS, EMBASE, CHEM ABS Data, EMBL, Sequence Search

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	REN HAIYING ET AL: "Combinative effects of a bacterial type-III effector and a biocontrol bacterium on rice growth and disease resistance" JOURNAL OF BIOSCIENCES (BANGALORE), vol. 31, no. 5, December 2006 (2006-12), pages 617-627, XP002445065 ISSN: 0250-5991 the whole document	1-11,15, 17,22
X	DATABASE WPI Week 200159 Thomson Scientific, London, GB; AN 2001-530414 XP002445791 & CN 1 300 547 A (UNIV NANJING AGRIC) 27 June 2001 (2001-06-27) abstract	1-11,15, 17,22

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
29 May 2008	18/09/2008

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer
Bilang, Jürg

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/052450

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 200415 Thomson Scientific, London, GB; AN 2004-152686 XP002445085 -& KR 2003 068 302 A (CHOI J W) 21 August 2003 (2003-08-21) cited in the application abstract -----	1-11,15, 17,22
A	DATABASE WPI Week 200652 Thomson Scientific, London, GB; AN 2004-169939 XP002445082 & CN 1 225 559 C (UNIV NANJING AGRIC) 2 November 2005 (2005-11-02) abstract -----	1-11,15, 17,22
A	DATABASE WPI Week 200649 Thomson Scientific, London, GB; AN 2004-169928 XP002445083 & CN 1 219 059 C (UNIV NANJING AGRIC) 14 September 2005 (2005-09-14) abstract -----	1-11,15, 17,22
A	PENG JIAN-LING ET AL: "Expression of harpinXoo in transgenic tobacco induces pathogen defense in the absence of hypersensitive cell death" PHYTOPATHOLOGY, vol. 94, no. 10, October 2004 (2004-10), pages 1048-1055, XP002445066 ISSN: 0031-949X figure 1 -----	
A	KIM JUNG-GUN ET AL: "Mutational analysis of Xanthomonas harpin HpaG identifies a key functional region that elicits the hypersensitive response in nonhost plants" JOURNAL OF BACTERIOLOGY, vol. 186, no. 18, September 2004 (2004-09), pages 6239-6247, XP002445067 ISSN: 0021-9193 page 6242 -----	

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/052450

C(Continuation): DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	LIU FENGQUAN ET AL: "The internal glycine-rich motif and cysteine suppress several effects of the HpaG(Xooc) protein in plants" PHYTOPATHOLOGY, vol. 96, no. 10, October 2006 (2006-10), pages 1052-1059, XP008081958 ISSN: 0031-949X page 1053 page 1056, right-hand column - page 1057, right-hand column -----	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2008/052450

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International search reportcovers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Invention 1: claims 1-11, 15, 17, 22, all partially

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

Invention 1: claims 1-11, 15, 17, 22, all partially

a method for enhancing yield related traits comprising modulating the expression of a nucleic acid encoding a HpaG protein, wherein said HpaG protein is represented by the sequence shown in SEQ ID NO: 2

Inventions 2 to 12: claims 1-11, 15, 17, 22, all partially

a method for enhancing yield related traits comprising modulating the expression of a nucleic acid encoding a HpaG protein,
wherein in each separate invention said HpaG protein is represented by one of the sequences shown in table A, i. e. SEQ ID NO: 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 and 28

Invention 13: claims 12-22, all partially

a plant comprising a nucleic acid encoding a HpaG protein, wherein said HpaG protein is represented by the sequence shown SEQ ID NO: 2 and the corresponding constructs

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Inventions 14 to 24: claims 12-22, all partially

a plant comprising a nucleic acid encoding a HpaG protein, wherein in each separate invention said HpaG protein is represented by one of the sequences shown in table A, i. e. SEQ ID NO: 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 and 28, and the corresponding constructs

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Invention 25: claims 23-47

A method for enhancing yield-related traits comprising increasing the expression of in a plant of a nucleic acid sequence encoding a SWI2/SNF2 polypeptide, the corresponding plants and constructs

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/052450

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 1300547 A	27-06-2001	NONE	
KR 2003068302 A		NONE	
CN 1225559 C	02-11-2005	CN 1451750 A	29-10-2003
CN 1219059 C	14-09-2005	CN 1451664 A	29-10-2003